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Technology Review

Edited at the Massachusetts Institute of Technology

**Nuclear Power:
Can We Live With It?**
A Discussion Among Experts



technology review

Published by MIT

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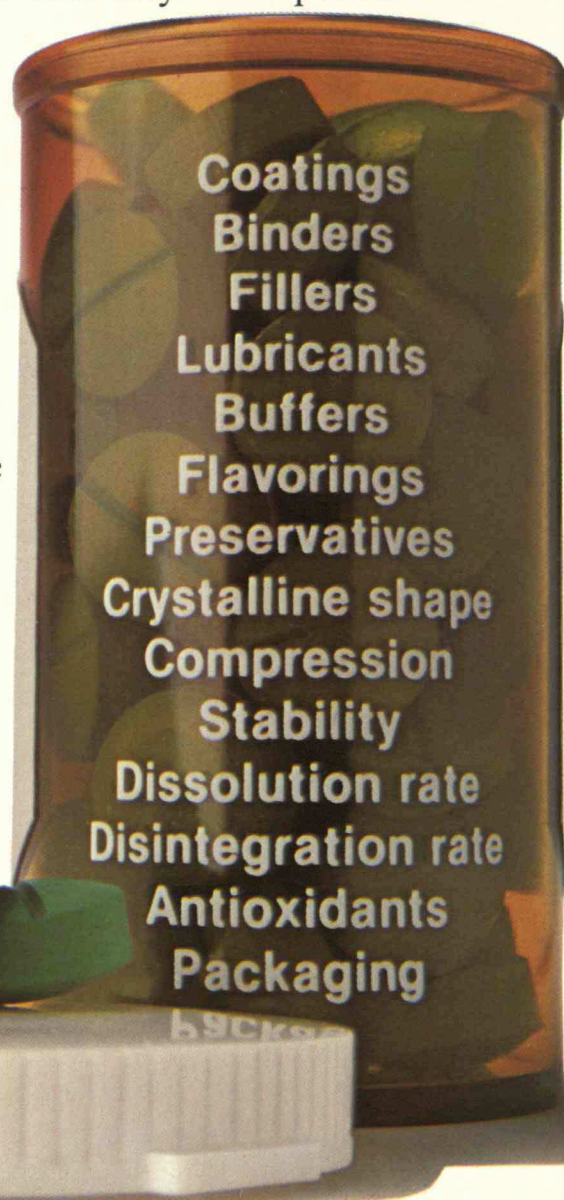
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Alumni Travel Program

1979-1980

For 1979, an expanded program of itineraries is offered, including New Guinea and a wider choice of programs in East Africa and India. Additional itineraries are also in the planning stage, including the Galapagos, southern India, the People's Republic of China and other areas.

The travel program is a special one for alumni of Harvard, Yale, Princeton, M.I.T., Cornell, Dartmouth, Univ. of Pennsylvania and certain other distinguished universities and for members of their families. Designed for educated and intelligent travelers, it is planned for persons who might normally prefer to travel independently, visiting distant lands and regions where it is advantageous to travel as a group. The programs avoid the excessive regimentation normally associated with group travel, and are planned to include generous amounts of leisure time in the course of travel to allow for individual interests.

REALMS OF ANTIQUITY: Journeys into the past to explore the history and civilization of the ancient world. One itinerary of 17 days—**VALLEY OF THE NILE**—offers a comprehensive and authoritative survey of ancient Egypt. Starting with the British Museum and the Rosetta Stone, it visits the great monuments of ancient Egypt stretching along the Nile Valley from Memphis and Cairo to Abu Simbel near the border of the Sudan, including a cruise on the Nile from Luxor to Aswan. A second itinerary—**AEGEAN ADVENTURE**—covers the archeological treasures of classical antiquity in the lands of the Aegean in a journey of 23 days. It includes not only the historic sites of ancient Greece but also a rare view of ancient cities in Asia Minor, including the ruins of Troy, and in addition includes a cruise through the Aegean to Crete and other Aegean isles. A third itinerary—the **MEDITERRANEAN ODYSSEY**—is a 22-day journey which follows the spread of classical antiquity into the western Mediterranean: the splendid ruins of the classical Greek cities of Sicily, the historic ruins of Carthage, ancient Roman cities in North Africa, and the fortress cities of medieval Crusaders on the rocky isle of Malta.



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THE SOUTH PACIFIC and EXPEDITION TO NEW GUINEA: The island continent of Australia and the islands of New Zealand are covered by the **SOUTH PACIFIC**, 28 days, unfolding a world of Maori villages, boiling geysers, fiords and snow-capped mountains, ski plane flights over glacier snows, jet boat rides, sheep ranches, penguins, the Australian "Outback," historic convict settlements and the Great Barrier Reef. The primitive and beautiful world lying slightly to the north is seen in the 24-day **EXPEDITION TO NEW GUINEA**, a rare glimpse into a vanishing world of Stone Age tribes and customs. Includes the famous Highlands of New Guinea, with Sing Sings and tribal cultural performances, and the remote villages of the Sepik River and the vast Sepik Plain, as well as the North Coast at Madang and Wewak and the beautiful volcanic island of New Britain. For both tours, optional post-tour visits can be made to other islands of the southern Pacific, such as Fiji and Tahiti.

CENTRAL ASIA AND THE HIMALAYAS: A choice of 23 or 29-day itineraries exploring the vast historic and cultural heritage of India, the untamed Northwest Frontier region of Pakistan and the remote mountain kingdom of Nepal. Includes the famed Khyber Pass, imposing Moghul forts, sculptured temples, lavish palaces, formal gardens, the teeming banks of the Ganges, snow-capped peaks of the Himalayas along the roof of the world, picturesque cities and villages, the splendor of the Taj Mahal, and hotels which once were palaces of maharajas.

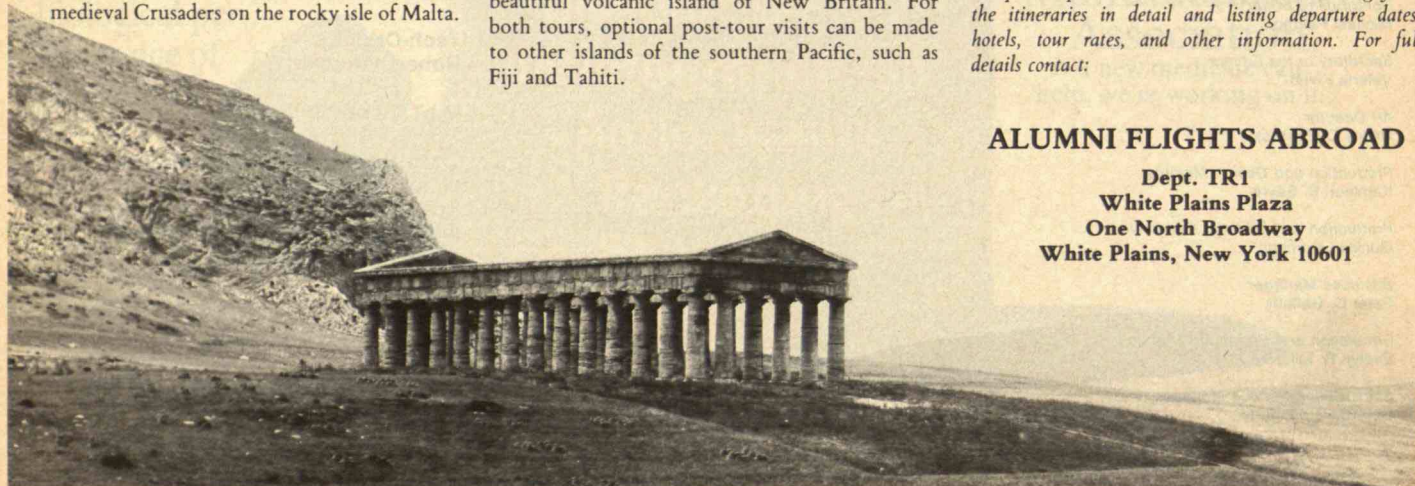
THE FAR EAST: Two itineraries which offer a fascinating insight into the lands and islands of the East. **THE ORIENT**, 29 days, is a classic tour of ancient and modern Japan, with special emphasis on the cultural treasures of Kyoto, and includes as well the important cities of Southeast Asia, from Singapore and Hong Kong to the temples and palaces of Bangkok and the island of Bali. A different and unusual perspective is offered in **BEYOND THE JAVA SEA**, 34 days, a journey through the tropics of the Far East from Manila and the island fortress of Corregidor to headhunter villages in the jungle of Borneo, the ancient civilizations of Ceylon, Batak tribal villages in Sumatra, the tropical island of Penang, and ancient temples in Java and Bali.

SOUTH AMERICA: An unusually comprehensive 28-day journey through the vast continent of South America, with dazzling pre-Columbian gold, ornate colonial churches and palaces, the ruins of the ancient Inca civilization, snow-capped peaks of the Andes, famed Iguassu Falls, the futuristic city of Brasilia, and other sights. Optional post-tour extensions are available to Manaus, in the heart of the jungle of the Amazon, and to Panama.

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A Conversation on Reactor Safety

Several weeks before the accident at Three Mile Island, Steven J. Marcus, our managing editor, proposed a new look — in the form of a dialogue among informed analysts — at the issue of nuclear reactor safety. The Nuclear Regulatory Commission had just taken exception to some of the conclusions in the nuclear risk analysis by Norman C. Rasmussen which N.R.C. itself published in 1975, the question of how to store and dispose of accumulating reactor wastes was gaining political momentum, and the nation's resolve to create a major nuclear power resource was clearly faltering.

By the time of the events at Three Mile Island, Dr. Marcus' plans were fairly complete. But those events (no one claims credit for having foreseen them) made the dialogue which took place on April 19, and which begins on page 32 of this issue, far more vital and timely than we expected.

The two-hour conversation is reproduced in this issue very much as it occurred. That the discussion flowed so smoothly and was so well informed is due in part to the careful preparation by Dr. Marcus and his associate Leonard Phillips; and it is also the result of the simple fact that the speakers were so well prepared on their subject that there were few, if any, moments of confusion and misunderstanding.

The whole episode is an experiment with a form of communication new to *Technology Review*, and we'll appreciate readers' judgments. — J.M.

On the Business Side

Though the editors are sometimes reluctant to admit it, operating a magazine can be fully as complicated — and nearly as crucial to its success — as editing one: advertisers to sell, subscribers to enroll, printers to pay, newsstands to reach, subscriptions to fulfill, renewals to obtain, lists to find, premiums to develop, commissions to pay, invoices to send, discounts to compute, rates to set . . .

All these activities, represented above by a dozen different verbs (and that's only a beginning), are now in the hands of three rather extraordinary people at *Technology Review*.

Peter Gellatly began his magazine career over 20 years ago in Cleveland and Pittsburgh for the *Saturday Evening Post*; then he joined the advertising department of *Newsweek*, where he was finally responsible for national advertising sales. He's been in Boston since 1973, and now he's given up a consulting career in magazine publishing and communications to join *Technology Review* as business manager.

With him, in what can now be unofficially described as our "business department," are Evelyn Milardo, who's been in charge of our circulation activities since 1977, and Dorothy Finnerty, subscription service manager, who enrolled her first *Technology Review* subscriber in 1969.

We're growing: more subscribers, more advertising, more color pages, more income, and more expenses than ever before. Mr. Gellatly, Ms. Milardo, and Ms. Finnerty have their hands full; and it is the editors' intention to prepare a magazine which will make them even busier. Readers' suggestions to this end are always welcome. — J.M.



E. Milardo



P. Gellatly

Radiation: Evaluating the Background

Thomas Najarian's article ("The Controversy Over the Health Effects of Radiation," November, 1978) was unsuitable for publication. The author assumed from the beginning what he was to have proved — that an excessive rate of cancer has been observed. The quantitative data are incomplete or in error.

For example, the representation of the degree of cancer risk from low levels of radiation from the newer (sic) studies appears to be a complete fabrication. The data are represented as scatter in a horizontal lens shape (figure, p. 78), with a preponderance of data points occurring around 20 rem, on the abscissa, and around 250 cancer deaths per 100,000 per year, on the ordinate. The data cloud cannot represent the studies cited in the article, for the average lifetime radiation exposures in those were in no case more than 15 rem. If there is a dose dependence for cancer induction, and there probably is, the data cloud should have a positive slope and not be parallel with the horizontal axis.

The caption states that the graph is made "excluding natural background radiation," but the procedure by which the effects of background radiation are excluded from the dose rate and cancer effects is not given.

The article is written with the bias of an adversary position. Information that is supportive of the author's position is promulgated without serious question. The older (sic) studies are arbitrarily truncated so that they may be dismissed. The homogenization of fact, fancy, and speculation throughout the article blurs rather than clarifies.

Victor C. Vaughan
Oak Ridge, Tenn.

Dr. Najarian responds:

Knowing how to adjust for natural background radiation is a difficult problem. As I mentioned in the article, studies in laboratory animals indicate that fractionating a given dose of radiation results in a much lower incidence of cancer than that caused by a given total dose. Our exposure to background radiation is at the lowest possible dose rate, many orders of magnitude lower than exposures to medical x-rays or nuclear work. Because of the long latency of low-dose, low-dose-rate exposure, any background exposure of a human over the age of 40 to 50 is probably not significant in causing human disease. If background radiation amounts to

6 rads by age 40, and if (as in animals) the incidence of cancer is only 0.1 or less than the incidence caused by 6 rads given all at once, then background radiation for a lifetime would be equal to 0.6 rads or less of occupational or medical exposure.

The article was intended to make the general point that calculated "doubling doses" from three newer studies indicate a cancer-inducing effect for those exposed to less than 50 rads of external radiation; this is 10 to 20 times greater than that predicted from a linear extrapolation of previous studies on humans exposed to high doses of x-rays and atomic bombs. Dr. Vaughn and others may not be convinced that these recent findings are real because of the borderline statistical significance and very low exposures of the groups involved. Additional research in the next several years should help to confirm or deny these newer findings which I summarized in a necessarily simplified manner.

The Uses and Misuses of Phillips

Robert M. Solow claims that economists cannot do experiments ("What We Know and Don't Know About Inflation," *December/January*, pp. 30-47). I thoroughly disagree: to the extent that economists make national policy decisions on the basis of such flimsy intellectual props as Phillips' rule relating wages and unemployment, they experiment without justification with the livelihood and well-being of every American.

My analysis of the Phillips rule applied to recent U.S. data suggest that, though the relationship may be meaningful in a relatively unchanging economy, it is meaningless or dangerous as a tool for guiding economic policy in the presence of grand uncertainty. Certainly in contemporary America the data scatter is so great that other meaningful variables (such as, perhaps, the rate of annual increase of energy production, the ratio of the annual budget deficit to gross national product, or the national defense budget) must be considered. Perhaps one should conclude that in the real world absolute and nominal variables cannot be meaningfully related after all!

Richard O. Whipple
Larchmont, N.Y.

Bay of Fundy Power: Not Yet Economic

G. F. D. Duff ("Tidal Power in the Bay of Fundy," *November*, 1978) states that the

benefit-cost ratio of the Cumberland Basin site was 1.2:1 based on a 30-year study period and 5.5 per cent real discount rate. However, the study period was 60 years, and the benefit-cost ratio for the site using the 5.5 per cent discount rate (which was not adjusted to remove effects of inflation) was 0.93:1. The benefit-cost ratio of 1.2:1 was obtained by reducing the discount rate to 4.75 per cent and increasing the assumed real rate (inflation-free) of fuel price escalation after 1990 to 2 per cent per year from 1 per cent.

The capital cost of the Cumberland Basin site was stated to be an estimated \$1.2 billion. This is in constant 1976 dollars; in current prices, this project was estimated to cost \$3.1 billion, with a completion date of 1990. It is true that the study indicates the Cumberland Basin project has potential as a future source of renewable energy. However, there remains a challenge to improve the economic and financial feasibility of the project prior to a decision to proceed with it. C. E. Zwicker
Ottawa, Canada

Mr. Zwicker is chief of economic studies of electrical energy (Energy Policy Sector) in the Canadian Department of Energy, Mines, and Resources.

Professor Duff responds:

I stand corrected on the figures which Mr. Zwicker cites. Furthermore, I fully concur with his view that tidal power poses a continuing challenge to research and development. But there is realistic hope of improved dyke construction methods, more efficient straight-flow turbines, and eventual multi-basin system gains.

It is exceptionally difficult to define overall cost effectiveness in the presence of transitions. Evidently, Fundy tidal energy is an option with cost comparable to other available modes of energy conversion. Recently we have witnessed a significant nuclear incident in Pennsylvania, a coal mining disaster in Cape Breton Island, and a fresh round of world oil price increases. Should such unhappy trends continue, Fundy tidal energy will surely become cost-effective, relative to more conventional sources. There is good reason to pursue the needed studies of it.

Speculations on Inflation

Robert Solow, in his article, "What We Know and Don't Know about Inflation" (*December*, 1978/*January* 1979), speculates on those factors which prevent or

inhibit downswings in the price level. One rather obvious factor seems to have been omitted.

Many businesses, rather than lowering prices, simply reduce their levels of production in the face of lowered demand. Frequently, they can maintain their profits by eliminating marginal production. In any event, if total profits do have to be reduced, they prefer to reduce output rather than price. Market-leader pricing, in basic industries, makes it possible to maintain price levels so that each industry, in effect, behaves as if it were a classic monopoly rather than a competitive system.

Another factor that enables many businesses to maintain, and sometimes even increase, prices in the face of lower demand is that the outputs of different producers in our complex system are rarely fungible. Competition is thereby inhibited.

We may conclude that businessmen have begun to realize that they do not have to behave in the self-destructive, competitive manner postulated by classic economic theory.

Carl H. Savit
Houston, Texas

I would like to suggest to Professor Solow a development which supports his speculations on inflation.

The transition in the early 1950s to steady inflation coincided with the dramatic increase in military expenditure for the Korean War. These high expenditures continue to the present, threatened only once by the rumored 1974 "peace dividend," which in turn coincided with the "unusually deep recession of 1974-75." Also in the early 1950s, military expenditure surpassed total American corporate after-tax profits — the source of research and development and investment for the civilian economy. This reinforced the perception that the military was America's principal growth industry.

The industries serving the military are a large and highly visible segment of the economy in a permanent boom (as a group but not individually, to the grief of employees). Further, a high concentration of high priced management and engineering talent puts these industries at the apex of the wage hierarchy. Thus labor can certainly be excused for believing any recessions to be mild and short and clinging to the wage structure.

President Carter hopes to curb inflation by cutting the budget deficit while increasing military spending (which has inherently inflationary characteristics of its

(Continued on p. 19)

Keep It Simple

Strike three.

Get your hand off my knee.

You're overdrawn.

Your horse won.

Yes.

No.

You have the account.

Walk.

Don't walk.

Mother's dead.

Basic events

require simple language.

Idiosyncratically euphuistic

eccentricities are the

promulgators of

triturable obfuscation.

What did you do last night?

Enter into a meaningful

romantic involvement

or

fall in love?

What did you have for
breakfast this morning?

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hind leg with two oval
bodies encased in a shell
laid by a female bird

or

ham and eggs?

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Science and Uncertain Futures



Kenneth E. Boulding is Director of the Institute of Behavioral Science and Professor of Economics at the University of Colorado at Boulder. He is a regular contributor to Technology Review.

A common view, both within the scientific community and outside it, holds that the business of science is knowledge. Certainly this view should not be despised. The sum of human knowledge has expanded almost exponentially for 500 years with the rise of science, resulting in abundant changes in human artifacts, in wealth, in the growth of the human population and its geographical distribution, and in the entire quality and pattern of human life. Indeed, those parts of the world which have been touched by the scientific revolution and those which have not form the great division in the world today. This barrier exceeds all other divi-

sions within these two parts, whether religious, ideological or cultural.

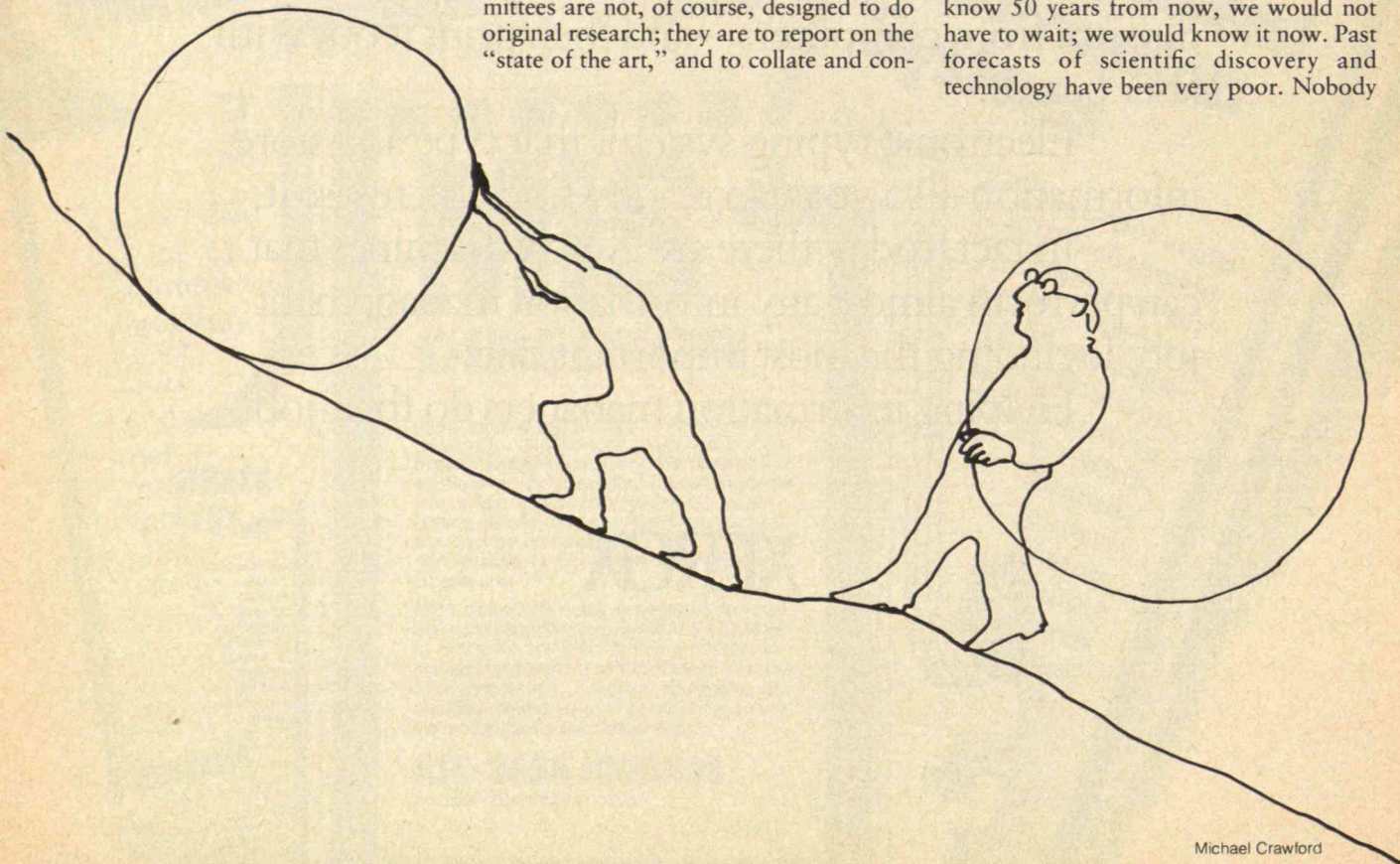
Nevertheless, the very drive of science toward more knowledge creates real difficulties in areas where knowledge seems stubborn to increase. This problem was impressed upon me particularly through my membership on the National Academy of Sciences Committee on Nuclear and Alternative Energy Systems, sometimes called the "CONAES" study. This committee is well over a year late with its report, detained in getting out a unified report which is acceptable both to the members of the committee and to the committee of review. The National Academy-National Research Council pattern of investigation, which is to appoint a committee of knowledgeable people in the field to write a report and another committee of knowledgeable people to review it, here seems stymied, in spite of the hard work and good will which has pervaded the project.

I think I can point to where the difficulty arises. The National Academy-National Research Council pattern is designed to inform society, and of course the government, what the scientific community knows about some particular issue at a particular moment in time. These committees are not, of course, designed to do original research; they are to report on the "state of the art," and to collate and con-

dense this into a reasonably accessible form. For small problems this procedure has worked moderately well, although one does worry about the number of unread reports gathering dust on the shelves. When something as all-encompassing as the energy problem is tackled, however, the method shows weaknesses. Much of what is significant about the scientific community's contribution to the energy problem is what the scientific community does not know, not what it knows. Understandably, the National Academy of Sciences and its committees are not so enthusiastic about what the scientific community does not know. Nevertheless, the scientific community must be scrupulously honest about what it does not know; otherwise, it is in real danger of losing its credibility and in danger of implying an understanding of things about which it is in fact ignorant.

Auguries of Ignorance

What then are some of the things which the scientific community does not know? In the first place, it does not know very much about the future of knowledge and technology. For a good reason: if we could predict what we were going to know 50 years from now, we would not have to wait; we would know it now. Past forecasts of scientific discovery and technology have been very poor. Nobody



Michael Crawford

The future of human and social systems are not uniquely uncertain; even the future of the climate and atmosphere and the oceans is unsettled. This was undisputed at a delightful workshop on the carbon dioxide problem in March, sponsored by the American Association for the Advancement of Science and the Department of Energy, where an interesting mixture of physical and social scientists established an unusual amount of communication. What clearly emerged from the seminar was that the uncertainties of the world climate and its distribution are very large indeed. On the assumption that the human race continues to burn up its coal and fossil fuels, and so increase the carbon dioxide in the atmosphere, models of the climatologists reveal that the general temperature of the earth will increase above what it otherwise would have been. Carbon dioxide in the atmosphere lets the sun's high-energy rays in but blocks the low-energy radiation coming from earth, producing the so-called "greenhouse effect." Most scientists agreed that this warming will take place mainly at the poles, that the temperature difference between the poles and the equator will decline, and that the general circulation and climatic zones will undergo radical changes. The Middle West might become a desert; the Sahara might bloom; and if the West Antarctic ice cap slips into the ocean, the sea level may rise 25 feet, which would be rather rough on the large part of

The standard answer of the scientific community to ignorance is, of course, a plea for more research money — as good a response as any. On the other hand, one has uneasiness here too. Suppose the systems we are investigating have very strong irreducible random elements in them. All the research in the world will not inform us about them; and one has the uneasy feeling that not only human and social systems have strong random elements but perhaps even climatological systems. Research can detect only the nonrandom, and while that is important, an area of irreducible ignorance may remain. Science has been extraordinarily successful in finding out what there is to know. All the science in the world will not find out what is not there to know. Accordingly, we should give far more attention to the study of how to make decisions under conditions of irreducible ignorance and uncertainty. Though not a very cheerful prospect, it gives more encouragement than delusions of certainty, for these are eventually certain to end in disaster. □

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Evolution: Equal Time for God



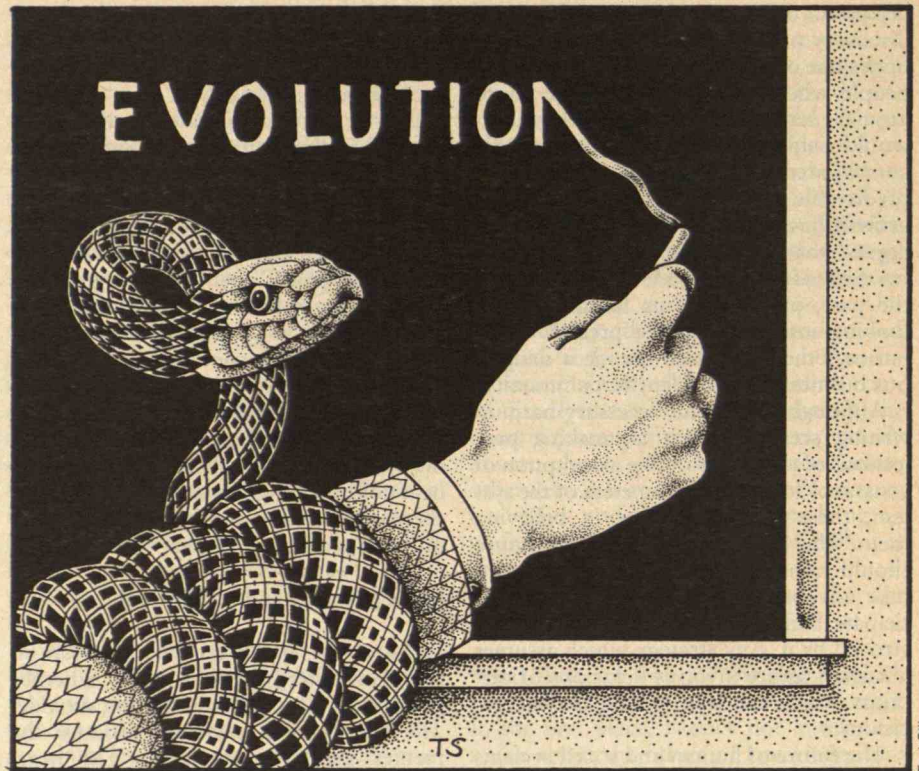
Robert C. Cowen, Science Editor of the Christian Science Monitor, is former President of the National Association of Science Writers and is a regular contributor to the Review. He holds S.B. and S.M. degrees in meteorology from M.I.T.

It is interesting . . . to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us. . . . There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved. — Charles Darwin, The Origin of Species.

Darwin said it well. One might think such a sentiment would delight the fundamentalist Christians who, 120 years later, insist that biology textbooks pay attention to the activity of a supernatural creator. But Darwin remains their classic *bête noire* as they press their cause before school boards, state legislatures, and even the staid Smithsonian Institution where, this spring, they were demanding the new "Dynamics of Evolution" exhibit be closed down or offset by an equally prominent display of creationist notions. This long-playing struggle has had a more damaging impact on the teaching of sound biological science than anyone not directly involved might think. Creationists have won few legal battles. But they have so intimidated many publishers and authors that Darwin would have as much trouble as "the Creator" finding himself adequately represented in many of the biology texts used in American public schools.

Editing the Evolutionary Text

A decade ago, creationists persuaded the California Board of Education to revise guidelines for biology teaching to state that the Book of Genesis presents a reasonable explanation for the origin of life and that special creation of species by



a supernatural being be taught along with evolutionary theory — a concept of "equal time" for their alternative views. The result has been a subtle rewriting of biology textbooks under pressure from California (a major textbook market).

Some changes seem innocuous enough taken on their own, for example, the statement "Paleontologists have been able to date the geological history of North America" became in one case "Paleontologists have assembled a tentative outline of the geological history of North America." Such changes are justified as reducing "scientific dogmatism" and eliminating "evolutionary assumptions" being taught as fact. And indeed, one has to agree that a particular change has sometimes toned down an overly absolute statement, as in the case where the original read: "Science is the total knowledge of facts and principles that govern our lives, the world, and everything in it, and the universe of which the world is just a part." This was revised to read: "Science is one way of discovering and interpreting the facts and principles that govern lives, the world and everything in it, and the universe of which the world is just a part. The scientific way limits itself to natural causes and to descriptions that can be contradicted, at least in principle, by experimental investigation." (see "The Science-Textbook Controversies" by

Dorothy Nelkin, *Scientific American*, April, 1976.)

However reasonable such individual alterations may often be, their net effect has been virtually to eliminate evolution as the explicit unifying principle of modern biology, which it is, from many biology textbooks. It is a quietly effective way to get biology instruction itself to propagandize the viewpoint that evolution is mere speculation that is strongly challenged by the Biblical creation story taken literally.

Creationists have been less successful in getting their demands for "equal time" enforced legally. In 1967, Tennessee finally repealed its famous "monkey law" prohibiting the teaching of evolution only to pass "equal time" legislation six years later. But this too was repealed when it was declared unconstitutional in 1973. A suit to force the National Science Foundation to withdraw textbooks developed by the Biological Science Curriculum Study (under constant attack by creationists) and, to put equal effort in promulgating the creationist view was lost. Likewise a suit to halt the Smithsonian display lost last December. Dale Crowley, Jr., director of the National Foundation for Fairness in Education, had contended the exhibit amounted to supporting the doctrines of "a religion of secular humanism." However, the judge

ruled otherwise, observing: "This is not a situation where the Smithsonian has put an unconstitutional condition on plaintiff's exercise of their belief."

At this writing, Mr. Crowley was appealing the decision. At this writing also, creationists were trying to get "equal time" legislation through the Iowa legislature while similar legislation was defeated this spring in Minnesota. Still, many creationists prefer the quieter, more effective approach of "persuading" educators and textbook publishers (some would say intimidating them). Thus Charlotte Glasgow of the Institute for Creation Research, a division of Christian Heritage College, in San Diego, Calif., has said: "We don't favor that approach. We'd rather be patient — educating the educators — than resort to legislative action."

No Sudden Aberration

And indeed they can afford to be patient. For while the creationists' legislative track record is poor, their long-term success in convincing publishers to soft-pedal evolution has been impressive. Those who think the creationist confrontation is a sudden aberration should look at what really happened after the famous Scopes "monkey" trial in Dayton, Tenn., in 1925. The defendant convicted for teaching evolution in violation of state law did win the appeal on a technical point, and the subject of evolution did become more fashionable in U.S. society at large. But textbook publishers and many authors took quiet note of the strong feelings in major Bible belt textbook markets and evolution was selected out of their books. Many professional biologists, who had the illusion that creationism was behind them, awoke rudely in the late 1950s and early 1960s, when science teaching was being revitalized in all fields, to discover that a century after Darwin, evolution still was unwelcome in precollege teaching. An analysis of the effects of the Scopes trial in *Science* (September 6, 1974) noted, "That the textbooks could have downgraded their treatment of evolution with almost nobody noticing is the greatest tragedy of all."

This continuing suppression of evolution, through voluntary restraint on the part of authors and publishers in the face of the strong feelings of a religious minority, hints that the phenomenon is deep-seated. It is not just the last-ditch effort of religious bigots. While the declared creationists are relatively few, they find wider sympathy. And publishers sense that they still must tread carefully.

Some observers explain it as a reflection of the mistrust of science and the authority of "experts" that characterizes the 1970s. Martin Marty of the Divinity School at the University of Chicago, for example, takes this view. He also suggests that the creationists may be part of the general reassertion of minority rights and identity. Also, he notes, there is widespread dissatisfaction with the public school system which helps creationists find allies.

Shaken World Views

But pertinent as such observations are, the root cause lies deeper in our culture and in human nature. The insights of Darwin and the theory of evolution they had inspired are a far greater challenge to the human psyche than the scientific revolutions of Copernicus, Newton, or Einstein. Ernest Mayr, zoologist and emeritus professor at Harvard University, pointed this out cogently in the June 2, 1972 issue of *Science* where he called it "the most fundamental of all intellectual revolutions in the history of mankind." He notes that it required not only the replacement of one scientific view by another but the rejection of widely-held views by an entire culture. It reverberated through "every metaphysical and ethical concept" held dear. Nor was it a sudden threat appearing without warning in 1859 when *The Origin of Species* was published. Dr. Mayr shows that the startling concepts and the mental upheaval they brought had started gathering force 250 years ago. Is it any wonder then that the evolution controversy hasn't settled down a mere century or so after Darwin?

Creationists often protest that, while as individuals they have a religious point of view, they are challenging evolution on scientific grounds. They insist that special creation by a supernatural agent better explains the fossil record and the findings of modern biology than does the self-evolution of living material systems. This can easily seem to be merely a deceptive ploy to avoid the unconstitutional implications of trying to promote religious views through the public educational system. I think the creationists mean what they say, although they undoubtedly are aware of the tactical wisdom of this approach. I also think they believe that they can explain the data of biology within their world view because to believe otherwise would be shattering.

If I'm right, and if as Dr. Mayr points out the challenge of evolution strikes
(Continued on p. 19)

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A Prescription for Information Overload Anxiety



Warren Bennis has been watching people and their organizations ever since studying for his doctorate in psychology (1955) at M.I.T.'s Sloan School of Management. He's now living in Aspen, Colo.,

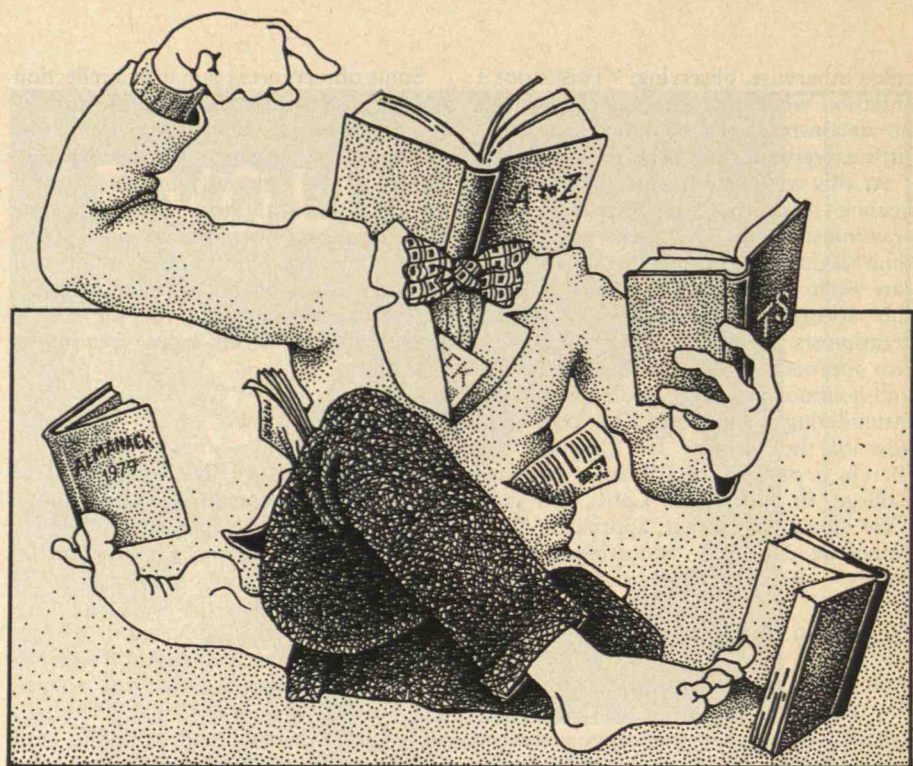
planning a new career after 20 years in academic administration at the State University of New York at Buffalo and the University of Cincinnati (President, 1971-77).

As we all know, ours is a poly-saturated, paper-polluted society; power resides in those who have the right information. Fortunes are made or lost, careers secured or shot, health enhanced or damaged by one factor — information.

Coterminous with the information-power equation is a dramatic increase in a national nervous disorder: Information Overload Anxiety (I.O.A.). This disorder is characterized by an obsessive-compulsive tendency to read everything about everything from anemones to zyzomys. It is especially contagious among managers and directors, whose will power is blunted by their incessant search for product and profit under any unturned stone; and its special victims are engineers-turned-managers, whose inferiority complexes about their place in the world of three-piece suits makes them singularly vulnerable.

I.O.A. is a killer disease made more pernicious by our collective and willful neglect of it.

The so-called cures for this disease are as pervasive as the information-pushers themselves. *Execu-Time* reports that Lance Shaw uses a timer: "He gives himself no more than 15 minutes for each periodical; when the timer rings, he tosses out the magazine and moves on . . ." Another one of the many regimens available at your local newsstand comes from Nobel Laureate Herbert Simon, quoted in *People* magazine: "Reading daily newspapers is one of the least cost-efficient things you can do. . . . Read the *World Almanac* once a year. What's happening you'll hear by lunch-time anyway." Russell Baker copes with I.O.A. by reading only the obituary page — "to make sure I haven't died" — and after ascertaining



that goes out to celebrate.

Cutting back to Simon's starvation diet or trading cerebration for celebration are only a few of the wonder cures. Many I.O.A. victims have tried others: keeping the abstract- and digest-pushers prosperous with subscriptions; sitting through speed reading courses; having an assistant predigest industry news and then picking his brains. Some have tried shifting to liquid Cronkite, and other sufferers have stopped their intake cold turkey.

None of this is necessary. Neither must you be sentenced to a death row of sentences. As a reformed I.O.A. patient, I can recommend a formula for dealing with this disorder. It is the surest, safest way to attain your basic minimum information requirement. For those of you who genuinely want to change and who feel that obituaries are unhealthy and the timer system mechanical, I present here the Fat-Free Daily Reading Diet (F.F.D.R.D.) guaranteed to satiate everyone from the freaky faster to the junk news junkie.

But first, three words about F.F.D.R.D.: ☐ Who needs it? The ambulatory generalists, the well-educated, intellectually curious, overstimulated crisis expediter. In short, you.

☐ Many nutritious items beyond the ordinary nosher's price range, or inaccessible to those not adjacent to the kiosk in Harvard Square or the newsstand in the Citicorp Building, have been eliminated.

☐ Faddists need read no further. You will not again see mention of such exotica as *Cahiers du Cinema*, *Blood Iron Age*, *Running Times* or *Hungarian Art Nouveau*. I choose my products on the basis of their health-giving balance, practicality, consistency, and absence of bulk.

Basic Maintenance Plan

F.F.D.R.D. is the reading plan to follow the rest of your life. It has been laboratory tested by patients who once seemed hopelessly mired in decadent reading habits but who are now reading normal, healthy lives. Once comfortable with it and sure of your new control, you may want to modify it to include some local options in your daily diet.

Group I: Newspapers. One daily. Absence of bulk clearly makes the *Wall Street Journal* the preferred choice, and no other major newspaper is delivered outside its region on the date of publication. Its editorials are peppy, nutritious, and infused with vital life-giving substances. As a daily regimen you will find its reviews of cultural events hearty and fat-free.

Group II: Newsmagazines. Diet must be limited to one; ingesting two reveals serious addiction. My preference for *Newsweek* is based on the belief that a healthy agent locates pain-in-hiding and identifies potential problems in the soft tissues of a listless society; it recognizes symptoms and points them out: racism

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before Dr. King's march, pollution before Rachel Carson, sexism before Betty Friedan, bureaucratization before William H. Whyte, Jr., consumer protection before Ralph Nader.

Group III: General Culture and Ideas. Few temptations here. Needed is one unsweetened, streamlined packet that reviews books, movies, dance, theater, music, television, the plastic and performing arts, architecture, urban aesthetics, graphic design, and the commercial arts. No such item exists in the U.S. In waiting rooms try *Vogue*; in England sample *The Listener*; on Sunday read the *Times*.

A warning about the Sunday *Times*: It has unquestionably brought more patients to terminal I.O.A. than any other single diet component. Reading the Sunday *Times* is like eating one peanut. It must be read only under a doctor's supervision, and you must first remove bulk to retain only essential ingredients: discussions of architecture, drama reviews, essays on arts and culture.

Group IV: Reference Books. This diet includes only one reference book — a dictionary with intellectual heft and clarity; an untrendy dictionary, but one that doesn't shy away from "DNA" or "glitch"; a dictionary with *helpful* pictures, but no drawings of nailheads or cows; one with a first-rate etymology and with type that can be read without an accompanying magnifying glass which makes you, no matter how hardy, feel like a geriatric case. The ideal dictionary also includes a section of the most commonly used German, French, and Spanish words, a basic manual of style, and some major dates in history. The dictionary that comes closest to meeting our minimum daily requirement is the *Random House Dictionary of the English Language* — unabridged. But unlike the new you, it is so overloaded with information you must not attempt to carry it about with you; instead leave it in an accessible place with a good light.

As reference supplements, I refer you to the following extras containing no fat, but which may be read only by those who have their appetites under control:

□ *The National Dictionary of Addresses and Telephone Numbers*, a Bantam paperback, includes an index of 50,000 useful address and phone numbers: all U.S. companies with annual sales of \$10 million and over, governmental agencies, foundations, educational institutions, museums, ballparks, symphony orchestras, public libraries, hotels, airlines, hospitals, and all those organizations you've been wanting to write hate letters to all (Continued on p. 88)



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Loch Ness: The Big One Got Away — Again

What are the large aquatic shapes in the cold, dark waters of Loch Ness?

We still do not know.

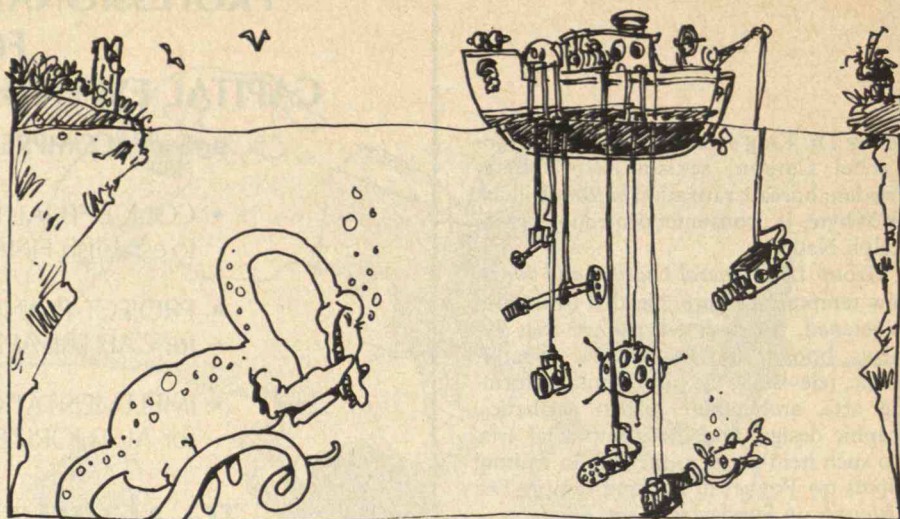
Our automatic cameras were triggered several times last summer when our sonar responded to large underwater objects, but the films showed no clearly identifiable images. Similar episodes occurred with our automatic cameras during the past winter, but there were no useful images.

Underwater photography is a challenge anywhere, and it is especially difficult in Loch Ness. The peat-colored water, although quite clear, acts like a giant sponge for light. Rain water which feeds Loch Ness passes through basins of peat in the moors of the surrounding mountains. The mountain streams and rivers — and ultimately the Loch itself — take on the brown color of peat in much the same manner that a cup of hot water takes the color of tea leaves. The peat color has high light absorption in the blue and green regions of the visible spectrum and is therefore most undesirable from a photographic standpoint: a beam of light with wavelength of 400 nanometers is attenuated so sharply that only one part in 10^{50} of the original beam reaches a target 11 meters away.

More Sensitive Camera Systems

Now Charles Wyckoff, who has been our photographic expert since 1975, has apparently broken this dark-water barrier with a new, special color film and processing system which will yield usable film speeds on the order of 20,000 to 30,000 ASA; there will be detectable images when the film is exposed with speeds as high as 100,000 ASA.

The new film is being combined with equipment, almost fully automated, in a new search for the legendary "monster" of Loch Ness. The system requires only occasional inspection and reloading. When a continuously operating sonar device detects the presence of an intruding creature, an onboard minicomputer processes the signal to determine that the target is large enough and in the correct position to be photographed. If the situation is favorable, cameras and powerful strobe lights are activated to make exposures every three seconds. In addition to



the primary cameras near the sonar, the system includes a camera off to the side encompassing both the primary cameras and their field of view, and another camera location about five meters in front of the primary cameras and well below the main field of view; this equipment is aimed upward so that it will give us a silhouette view of any creature which invades the field.

Each camera has its own 100-watt-second strobe light, and this year we have added four strobe lights to cover the main field of view of the primary cameras. The amount of light being used is thus at least five times greater than previously, and we have an evenly illuminated object space out to about 20 feet in front of the camera. With at least five times more light and some 20 times more effective film speed, our system sensitivity has been increased by at least two orders of magnitude, and we hope that this advance will lead to at least one good picture which will enable somebody to make a positive identification of the creatures which appear to inhabit the waters of Loch Ness.

But these cameras remain immobile, anchored in Urquhart Bay. So we are now enlisting aid from an animal known both for its mobility and its intelligence: we have trained two bottlenose dolphins to carry automatic sonar-activated cameras into the loch; they'll pursue any large moving object they encounter and try to position their cameras for photographs. So a new phase of the hunt is on!

A Large, Moving Sonar Target

The exciting news of our 1978 research activities is of two types. First, there was a most successful tracking by Tom Cummings and Larry Kozak of Klein Associates of a large, moving underwater object from a moving side-scan sonar (see photo). Here is how Tom describes that incident: "Shortly after our first contact, there seemed to be a burst of noise, and

then the target generated an underwater wake clearly evident for three minutes at about four knots."

This is one of the first indications that the large, moving, underwater objects we have previously detected by sonar may emit sounds. (In this case, the sound clearly has components in the 50-kilohertz band and above.) The dimensions of the target — 2.5 to 3 meters wide — are similar to those assigned in 1972 and 1976 to targets observed with other sonar systems.

The second important result lay in the optical verification by R. T. Holmes of Heriot-Watt University, Edinburgh, of our high-definition sonar imaging (see photo). Martin Klein's sonar image of an aircraft on the bottom of the lake was clear enough to show cylindrical engine cowlings and related shapes; and when Mr. Holmes lowered a camera to the site he obtained film which verified all the details in the sonar pictures.

As a result, we can positively identify the plane as a Wellington, downed during World War II. But the real significance was to prove the effectiveness of high-definition sonar imaging — a technique which may ultimately prove to be the best way we have of identifying the Loch Ness animals should they continue to thwart our underwater photographic efforts.

Sonar Target Mapping Activities

Meanwhile, there's been substantial progress on another front — the exploration of other targets on the floor of Loch Ness. The dark waters of the Loch have before made it difficult — almost impossible — to put divers on particular sonar targets. Last summer Professor Harold E. Edgerton of M.I.T. changed that by pioneering the use of active sonar information to help divers find their targets on the bottom of the Loch.

The method was simple: our ship was anchored at bow and stern, and a vertical pipe with a side-scan transducer at the



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But standard lightwave systems will require *miles* of the fiber, produced at low cost and to specifications nothing short of microscopic.

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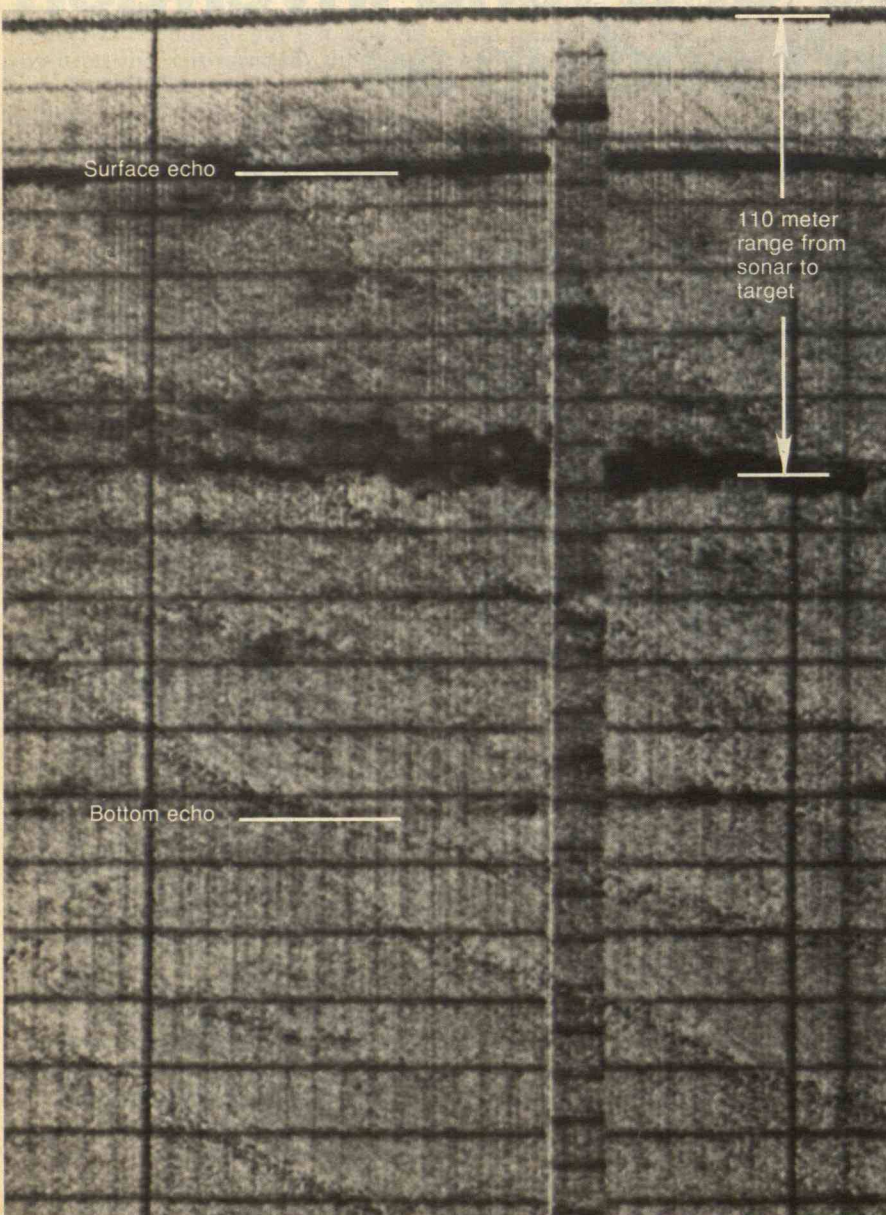
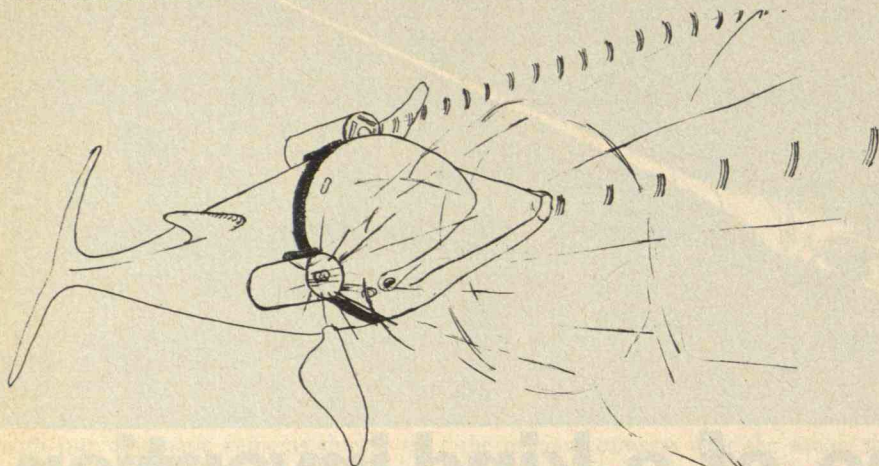
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1979 at Loch Ness will be known as the year of the dolphin. Because of their mobility, speed, intelligence, and built-in sonar, two dolphins have been trained to wear a camera-strobe-light harness and to search out and photograph large moving objects under the loch. The 35-mm. cameras will be

activated by a sonar trigger that will determine when the object is at the correct distance. The dolphins will be "rewarded" by a chirper whose sound tells them that they will receive a fish at the end of the session. (Drawing: Charles Wyckoff)



bottom and a compass at the top was lowered about three meters into the water. Thus the direction of the sonar beam could be observed and recorded as the pipe was rotated; and since we could measure the position of the anchored boat with sextant readings to several fixed shore points, we could easily locate targets and even readily determine their sizes. Divers were observed by sonar as they moved about and we used an underwater telephone system (wire) on several dives to link the diver with the ship.

The principal objects of this study were the curious stone circles which we've observed on the floor of the Loch, in 20 to 40 feet of water, during previous expeditions. We previously postulated that these circles were made by early man — thus linking them to ancient stone circles on land, such as those at Clava near Inverness, Scotland. But last summer's divers found the rocks piled only loosely, and it now seems that these circles represent spoil dumped from barges during excavation of the Inverness-Loch Ness canal.

Thus another mystery of this much-studied lake may have yielded to our increasingly sophisticated technology. But the ultimate question of living inhabitants in these dark, storied waters remains a forceful magnet for a growing circle of investigators.

Robert H. Rines and Howard S. Curtis are, respectively, president and executive officer of the Academy of Applied Science. Dr. Rines, who studied physics at M.I.T. in the Class of 1942, is a lawyer who has specialized in innovation and patent law; he is the founder of the Franklin Pierce Law Center in Concord, N.H. Mr. Curtis was formerly director of public relations and secretary of Brown University. □

Left: Quoting from the expedition report: "... On Friday, July 21, 1978, at 16:30 the side-scan sonar, while running the length of the Loch in the middle north of Urquhart Bay, recorded an extremely strong contact followed by a diverging underwater wake indicative of a large moving object, 110 meters from the transducer which was being towed at a depth of 35 meters in 215 meters of water. The strength of the wake far exceeded that from surface boats and, in fact, was on the order of that expected from a submarine. Shortly after the first contact, the recorder detected a noise burst, following which the target generated an underwater wake clearly evident for three minutes at about four knots. ... Conclusion: target was a large animate underwater object." (Photo: copyright 1979, Klein Associates, Inc., and the Academy of Applied Science)

Letters

(Continued from p. 4)

own). After reading Professor Solow's discussion, we can certainly expect this policy to fail.

Gordon Burck
Brooklyn, N.Y.

Robert Solow responds:

Mr. Savit has an interesting point. I didn't dwell on business pricing practices because it's not a specialty of mine; but I'm certainly not one of those who believes that the neat model of perfect competition applies all across our economic system. The difficulty with an explanation that rests too heavily on monopolistic pricing practices is that it seems to need increasing monopoly to account for increasing inflation-proneness of the modern economy. The experts don't seem to be able to detect a change in the extent of monopoly or near-monopoly. That is why I tend to fall back on the notion that diminished economy-wide risk of depression may account for a diminished willingness to cut price in soft markets.

Mr. Burck's observation makes sense in this very context. Any dependable source of sales is likely to turn an industry's thoughts away from price-cutting. Besides, a rumor has it that the federal gov-

ernment and the Department of Defense are not the most aggressive bargain-hunters in history. (Remember, though, that the existence of a dependable source of demand can be a blessing for the economy as a whole. As Jane Ace used to say, you have to take the bitter with the better. If you never heard of Jane Ace, boy, have you missed something.)

Corporate Leadership

I read with interest the remarks in the December/January issue (*Warren Bennis: "Rx for Corporate Boards,"* p. 12) regarding corporate boards. Surely I have no disagreement.

I write mostly to say that some of the ideas Dr. Bennis and others helped launch a number of years ago are clearly taking hold. The notion that corporate leaders should be more public and less private is no longer novel: the point worth noting at this juncture is that this idea is becoming widespread.

A lot of people look at Irv Shapiro or Reg Jones as nearly unique. What interests me as an individual in public affairs work is that Irv finds this to be far from true. He believes that many if not most executives are going this route.

Carl B. Kaufmann
Public Affairs Department
E. I. duPont de Nemours and Co.
Wilmington, Del.

Cowen

(Continued from p. 11)

deeply, the "equal time" controversy is no mere nuisance that will fade away. It finds echoes in people who nominally don't object to evolution at all but who nonetheless feel its challenge.

For biologists, then, this is not a peripheral issue and it should be given critical attention. As biologists themselves admit, the controversy shows they have done a poor job in conveying the essence of their science to the public. They can and should try to correct this. It means taking time to lecture, to write, to appear on television. It means analyzing why their science stirs people so deeply and speaking directly to those basic concerns. They are old familiar concerns of who am I, why am I here, where am I going. It is not enough to present the facts and theories of the life sciences, striking as the insights may be of the living world. People want to know how these can be made part of a meaningful world view that does not threaten one's sense of self and one's sense of place in the cosmos. As Darwin said, "there is grandeur in this view of life" which science is revealing. And whether you join Darwin in believing that it all was started by "the Creator" or not, it is this sense of grandeur that biologists need to convey. □

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Robert Taylor Dawes, Class of 1926

The traditional Japanese management styles are often characterized by three traditional short poems, or *haiku*:

□ "If the cuckoo won't sing, kill it." This characterization, by Oda Nobunaga, powerful 16th century lord who conquered central Japan, exemplified dictatorship. Traditionally, military lords used a rigid, pyramid-like scheme of ranking, and appropriately rewarded and punished their troops to preserve discipline. Today, Western businesses use the same type of organization and motivation, and as one result employees may be fired at any time by superiors — one reason many Western managers and employees "work and worry." Japanese managers hold that worry is not good for an employee or a company, and that where it exists because of company policies, management has failed to cope adequately with individuality — and the real human need for job security.

□ "If the cuckoo won't sing, make it sing." A characterization of Toyotomi Hideyoshi, Oda Nobunaga's successor, this management style may be caricatured by the mule and carrot story: to convince a mule to pull a wagon, put a carrot in front of him while whipping him from behind. This management "method" is based on the view that average people dislike work and avoid it whenever possible. Therefore, control by coercion, titillation, intimidation, or fear-provoking threats by authoritarian leadership is appropriate and necessary to achieve productive results.

As applied in ancient Japan, this philosophy led to ruling Samurai who were more or less equal and tightly controlled by their lord — a despotic central authority. But as they occupied more territory, these rulers were forced to decentralize their forces to maintain control. When leadership changed, resulting instabilities could seriously affect the lord's power.

□ "If the cuckoo won't sing, let's wait until it does." As practiced by Tokugawa Ieyasu, Toyotomi Hideyoshi's successor, the idyllic philosophy implicit in this *haiku* brought 250 years of peace, and it is the basis of the modern Japanese business management system. Practitioners of Ieyasu's style of management assume that the average person finds work natural and pleasant, is productive, and will exercise self-control. Therefore, suitable goals and reasonable motivation — never intimidation or threat — are appropriate for encouraging good work habits and the achievement of objectives.

Since World War II, management techniques

Business Management In Japan

by Mitz Noda

"If
the cuckoo won't sing,
let's
wait until it does."

A paternalistic corporate environment
based on
lifetime employment,
assured promotion, and mandatory
retirement
has
given Japan uniquely efficient and
productive industries.



drawn from this philosophy have given Japan mounting prosperity, have assured job security, and have perpetuated business institutions. However, Japanese managers have experienced enormous difficulty in gathering evidence to prove the superiority of this seemingly low-key management motif. A clue to understanding this difficulty is that management effectiveness is measured in Japan by both productivity and the well-being of employees.

The House of Mitsui — a Business Success Story

Consider the House of Mitsui, which started as a small shop in 1625 — and therefore predated the Bank of England by over 50 years. By 1946, when during the American occupation it was split into several companies, the House of Mitsui had innovated management operations that are today the core of traditional Japanese management practice.

The origins of the Mitsui, a Samurai family with lordly rank, can be traced back 800 years, when they are known to have settled near Lake Biwa in Central Honshu. In the upheavals following the collapse of the Ashikaga Shogunate in the 16th century, the hereditary castle of the Mitsui family fell before the assault of the military strongman, Oda Nobunaga. Exiled in Ise Province east of Nara, the Mitsui later welcomed the long peace ushered in by the rule of Tokugawa.

The Tokugawa family established four different classes of people — in descending rank, the Samurai, farmers (ranked second because they were the chief suppliers of the rice economy and the chief tax source), craftsmen, and merchants. By the end of the 18th century, the mercantile class had come to dominate society through financial power and strong, Samurai-style organization. One of these was Sokubei Mitsui, who early in the 17th century — when he was head of the family — exchanged his Samurai armor for the kimono of the merchant and embarked on a modest venture as a brewer of sake and soy sauce. Largely through the shrewdness and thrift of his wife Shuho, the modest venture succeeded. As business flourished, the Mitsuis added lucrative banking and trading operations.

Sokubei's sons inherited their parents' commercial talent — and the youngest of the four, Hachirobei, was without doubt an entrepreneurial genius. When the father died in 1633, Shuho appointed Hachirobei to head the family business, which was by then called "Echigo-ya."

By catering to the common people and selling

"If
the cuckoo won't sing,
make it sing."



moderately priced goods for cash, Hachirobei Mitsui quickly outstripped his competitors and developed a shopping center in Edo, now Tokyo. The Echigo-ya became a mecca for shoppers, publicized by the work of gifted artists who were patronized by Hachirobei. Hachirobei's innovations in retailing, publicity and finance brought rapid success — the family's own business operations were extended to Kyoto and eventually to Edo and Osaka. Within his lifetime the House of Mitsui became a nationally recognized institution.

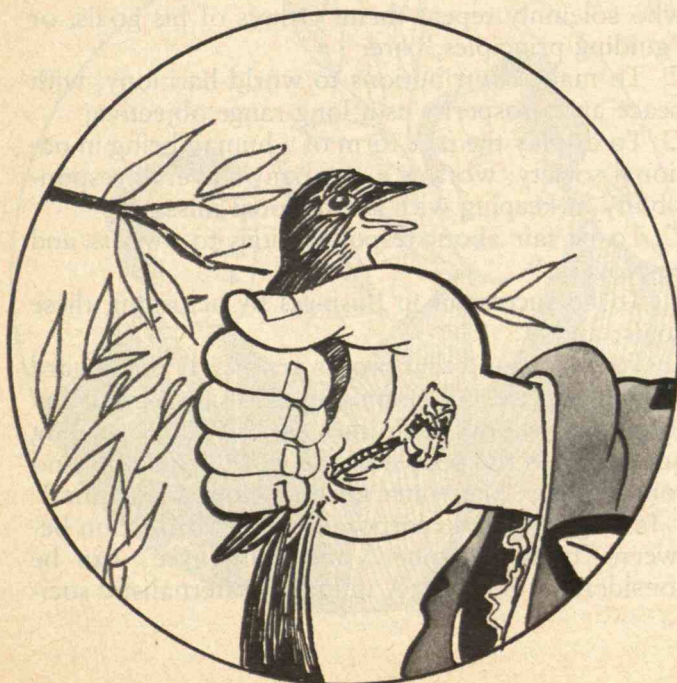
In 1683 the family dry-goods business was separated from the Mitsui's banking operations and reestablished under the name of Mitsukoshi. Headed by a branch family of Mitsui, it became Japan's largest department store and still dominates Tokyo's central shopping area near the famous Ginza.

When Hachirobei died in 1695 at the age of 73, he left six sons with a legacy of bold but sound enterprise. One of Hachirobei's most sagacious acts was to ensure the perpetuity of his family business system by structuring an enduring partnership in his will. He allotted each of his six sons a portion of the inheritance and stipulated that each portion of the business be managed by someone outside the family. He also specified business organization and management techniques, a code of ethics, and the relationships and personal conduct expected of family members. The establishment of this document by consensus into a formal constitution for the House inaugurated true managerial decision-making in Japan.

The following points summarize these traditional Mitsui business principles:

- ☐ Although diversified and decentralized, the family business is administered collectively, a procedure upheld by consensus. Mitsui was managed by the chief-*banto*, not a member of the Mitsui family, whose primary job was management development, including finding qualified replacements for himself and key managers. All but the most important decisions are made at the lower levels of the management hierarchy.
- ☐ Opportunities are provided for growth at all levels of management.
- ☐ Job security is accomplished by lifetime employment for regular full-time employees.
- ☐ In general, a worker's rank is determined by age and length of service. The senior employee guides the development of subordinates and gives them opportunity to exercise leadership. Thus, many assistant manager positions are opened for younger

"If
the cuckoo won't sing,
kill it."



people. Mitsui hires only young employees, retaining them for life. Sooner or later each is likely to be promoted. Personnel evaluation systems are considered unfair to employees. Mitsui strives to promote when promotion is due and retire when mandatory retirement (generally by age) requires. Actual criteria for promotion among the Mitsui enterprises vary, however: supervisors at Mitsui Mining are necessarily 40 or over; but at the Mitsui Trading Co. promotion is limited to capable men, with age a secondary consideration.

□ Nepotism is prohibited at all levels of management. Even the chief-*banto* cannot hire a relative into Mitsui.

□ Each summer and winter every employee is given a bonus derived from company profits. The size of the bonus is determined by team effort; no individual performance review is made.

□ Management makes every effort to keep employee morale high. Participatory entrepreneurship is encouraged, and a powerful personnel division maintains recreational facilities and provides opportunities for social gatherings.

□ To stay in tune with distribution and marketing systems abroad, employees are rotated around the world: top management personnel are shifted every three years, subordinates every four years. Such rotation also provides the opportunity to learn how other managers operate and encourages uniform managerial practice.

Mitsui's management philosophy has worked successfully for over 300 years — quite a testimonial for Sokubei and Shuho, progenitors of the family enterprise — and the family.

Employee Indoctrination for Employment Stability

Principles of behavioral science are applied rigorously throughout Japanese industry to increase employee solidarity. The impact of this practice is to supplant a worker's personal goals with company goals and with the feeling that Japanese enterprises are the basis for the prosperity and stability of the nation.

In Japan — unlike in the U.S. — it is generally held that strict government controls that regulate business will bring progress, prosperity, and a better society. The morality of Japanese leaders — private and public — is therefore of paramount importance. As described by Fukazawa Yukichi, President and

founder of Keio University, "management morality" is built on the following philosophical points:

□ Happiness is having work which you can carry out throughout your life;

□ The saddest thing is to have an education but no humanity;

□ Loneliness is not having a job;

□ The most disgraceful thought is to be envious of someone else's life style;

□ The most honorable thing is to give without thought of reward;

□ The most beautiful thing is to love and care;

□ The most terrible thing is to tell a lie.

The Shoshi Co. serves as an example of the pervasiveness of morality in Japanese business practice. When Furusawa Eiichi established Shoshi in 1873, he authorized three principal goals for the company: to make inexpensive paper for the public, to do service to the country, and never to think of profit as the major company objective — the last, a goal which is at odds with the emphasis Western managers place on the "bottom line."

Techniques for maintaining high worker morale that are unknown in Western companies are part of many Japanese workers' daily routine. Each working day at the plants of Matsushita, a leading producer of electronics and electrical appliances, young women workers do brisk calisthenics in time with recorded music. Then section chiefs read aloud the moralistic principles of founder Matsushita (such as "Seek progress through hard work") to workers, who solemnly repeat them. Others of his goals, or "guiding principles," are:

□ To make contributions to world harmony, with peace and prosperity as a long-range objective;

□ To display the true form of a human being in national society; work is a company's overall responsibility in keeping with the national mission;

□ To be fair about responsibilities to owners and employees;

□ To be successful in business by achieving these goals; and

□ To understand that profits are merely the reward of good service. All employees also sing a company song that includes such lines as, "[We are] sending our goods to the people of the world, endlessly and continuously, like water gushing from a fountain."

In large Japanese corporations the distinction between "family member" and "employee" can be considerably blurred. A uniquely paternalistic soci-

The senior employee guides the development of subordinates and gives them opportunity to exercise leadership.



ety often nucleates around a business, as described by Saizo Idemitsu, the founder of Idemitsu Kosan Co.:

"One might question how I could produce respectable and dependable people. The method was simple but very difficult to practice. When I started in my own small business in Moji more than 50 years ago, mothers came to my company with their sons fresh from primary school. At their request for me to take care of their children, I made up my mind to bring them up in place of their mothers. Ever since, I have translated maternal love into action on every occasion and in every appropriate form to my employees. This is what now is called paternalism. The employees that I raised are never dismissed. We are one big family and have no need for such things as time sheets, time clocks, and labor unions. When my employees or their children get married I give them housing and family allowances. I profess myself to be their mother and take a parental attitude toward their joys and sorrows. In short, affection and loving kindness produce respectable people. My company has many employees who carry on my parental love, guaranteeing the perpetuation of my ideas."

Such familial qualities, augmented with nationalism, are espoused by many Japanese companies in the belief that they will contribute to the happiness — and ultimately the productivity — of employees. Three prominent business leaders offer similarly paternalistic philosophies:

□ Eiji Toyota, President of Toyota Motors: "Toyota Motors has dedicated itself to creating a more affluent society by providing it with cars. Workers will find true happiness in working, because work will always be the basis of development of society."

□ Katsuji Kawamata, President of Nissan Motors: "[Nissan's aim is] to continue contributing to the national economy by employing many people and sustaining many lives."

□ Nisao Makita, President of Nippon Kokan: "Building one's own life with one's own hands has a severity comparable to the seriousness with which a lion stalks its prey. You are taking a job for yourself but, in effect, your work will improve the company and contribute to society."

On special occasions such as *nyushashiki* (a new employee's starting day), the launching of a new ship, or the opening of a new office, company presi-

dents read to employees a "creed of service" that includes thoughts similar to those just presented. In some companies employees repeat the company creed daily before work — and with utter sincerity.

Employment for Life — "Sushin Koyo"

The practice of hiring regular employees for life, described by Saizo Idemitsu, is almost universal in Japan. It is strikingly different from the mobility of workers and management among Western corporations, and in Japan the practice owes much of its success to a philosophy of patience described by Tokugawa Ieyasu: "A man's life is like walking a long road with a heavy load on one's back. Do not hurry. Have patience. If you consider that inconvenience and discomfort are normal, you will have nothing to complain about. If you wish for something, remember the times when you were in want."

Lifetime employment, or *sushin koyo*, is not law, but a centuries-old tradition. It is one of the ingredients of Japanese managerial success. Under the terms of *sushin koyo* Japanese management tends to hire only young employees fresh out of school; therefore, the work force of Japanese companies is younger than in many American companies. For example, the average Toyota Motors plant employee is 32 years old; in the U.S. the average age is closer to 42 years.

Mobility of employees among companies is unthinkable. Even executives are never brought in from outside the organization. A Japanese executive must come up through the ranks of one company, progressing from secretary to assistant manager to manager and to director.

Lifetime employment actually amounts to about 35 years of service. Average mandatory retirement age in most large Japanese firms — strictly enforced — is 55 to 60 years for male employees. The stated retirement age for women is the same as for men, although in fact it would be rare for a woman to remain employed much past the age of 30. The retirement age may differ by employee rank: higher-ranked employees are allowed to work to an older age; senior directors often continue in their positions beyond the 55-year limit.

Employees who retire after 35 years of service receive a lump-sum amount that is equal to three times their average annual pay; for many retirees this comes to a total of \$100,000 to \$200,000, tax free. Some top executives and governors receive as much as \$1,000,000. Employees who resign are consid-

ered retired and receive retirement pay according to their length of employment.

Sushin koyo has pervasive effects on Japanese society: unemployment in Japan is normally only about 1 to 2 per cent, and the number of days lost due to strikes is only one-eighth that in the United States. Japan has the lowest crime rate of the industrial nations; personal savings (per capita) are more than double those in the U.S.; current capital investment in new equipment is double the U.S. total. For their efficiency and magnitude of output, many high-quality Japanese businesses — for example, ship-building, steel, optics and photography, electronics, cars, motorcycles, and bicycles — are the envy of many other industrial nations.

One interesting effect of *sushin koyo* is its encouragement of innovation and productivity. Employees are not inhibited from suggesting how to improve a work procedure, even if their improvement may eliminate their jobs, because they know such an eventuality will lead only to transfer within the company — possibly upwards — and certainly not to a lay-off.

Seniority, Promotion, and Pay — "Nenki Joretsu Seido"

The practice of promotion by age and length of service, or *nenki joretsu seido* prevents young people from becoming managers in Japanese companies. In many companies it is 16 to 20 years before one may hold a title. However, all over the age of 37 have the chance of promotion.

Young newcomers are told that one day each will be a manager. Since all promotions come from within a company, young people do not feel a competitive pressure to achieve their promised management positions. Rather, they concentrate on their work — not on the politics and gamesmanship of promotion as do many young Western employees — and they look forward to security, promotion, and steadily rising income while their children are growing. Older employees feel they are societal leaders.

The Japanese pay system rests on a formula in which the variables are age and education — and in general only these two factors. Base-pay is not set by the kind of work done, efficiency, or capacity to perform work. Although some consideration is given to competence and performance, salaries are primarily a function of length of service, and raises are almost uniform for each age group. Some exceptions: there are family allowances based on the number of de-

A typical
decision-making scenario:
After a middle-manager-in-charge
makes a decision,
he asks his superior to
meet with him
at a restaurant or
lounge
on his way home.

There they
will discuss the decision
informally,
in a relaxed atmosphere.



pendents and quite unrelated to an employee's performance; attendance allowances, hardly a critical test of job competence; and a job-rank allowance, which is related closely to the nature of the work performed.

A different formula applies to top executives: the pay system for managers depends more on performance and ranking than on a base-pay formula. Promotions within top management are determined by performance and salaries are scaled accordingly.

The "Ringi" System of Decision-Making

About 90 per cent of all Japanese enterprises use a decision-making system, called the *ringi* system, in which middle management makes choices and top management approves those choices. In Japan, decision-making (big or small) is strictly the responsibility of middle management — the operating people, project managers, and specialists. Top executives are involved only enough to see that everyone at the working level is satisfied with the final choice.

A typical decision-making scenario: after a middle-manager-in-charge makes a decision, he asks his superior to meet with him at a restaurant or lounge on his way home. There they will discuss the decision informally, in a relaxed atmosphere. The top executive may ask a few questions about the group members involved in the decision-making process to be sure that all appropriate persons were involved and that the decision was unanimous, and he may discuss possible alternatives. When he agrees to the decision under these conditions, he does not feel that it has been imposed upon him. A few days later the executive will receive official documents for his formal approval.

Such decisions are said to be made behind the scenes, or in *ura*. Once the decision is made, it is announced up front, or in *omote*. Major decisions are announced incrementally to minimize resistance. In this way changes wrought by a decision are less upsetting and more readily accepted. This secretive decision-making, done in *ura* — is entirely consistent with the paternalistic relationship of Japanese managers to their employees. As Yajiro Idari, President of Daimaru, explains: "Since Daimaru Department Stores were established 250 years ago, we have always stressed justice before profit. When making decisions, you must adjust quickly and flexibly to changing times — but always consider the pains and troubles of others." And that is in *omote*.

Communication

Effective managers in Japan always try to deal with subordinates in a way that leads to superior performance. Management in Japan stresses, "Do not be afraid to make mistakes," and subordinates speak out about their mistakes, determining to correct them. According to Akio Morita, the President of Sony, "A top manager's voice is over-amplified and lower echelon voices are over-filtered. Face-to-face communication is the most critical means to solve the misunderstanding. Managers should listen and let subordinates speak. I love to hear crazy ideas."

Decision-making and communication tend to start at the top of Western management. But during routine communications, Western middle managers may unwittingly distort the meaning of memoranda that pass their desks by adding emphasis in cover letters to higher-level directives and circulating both together to their staffs. Should a mistake result, it tends to snowball, leading the people involved to point back and forth at each other trying to fix responsibility elsewhere.

The Japanese manager, on the other hand, tries not to commit himself in writing. Japanese businessmen prefer face-to-face communications, and they keep paper work to a minimum. A manager may spend most of his day walking around the plant and talking to people. President Toshio Doko of Toshiba puts it vividly, "Speak to subordinates even while in the rest room; managers are the ones who should say, 'How are you?' first."

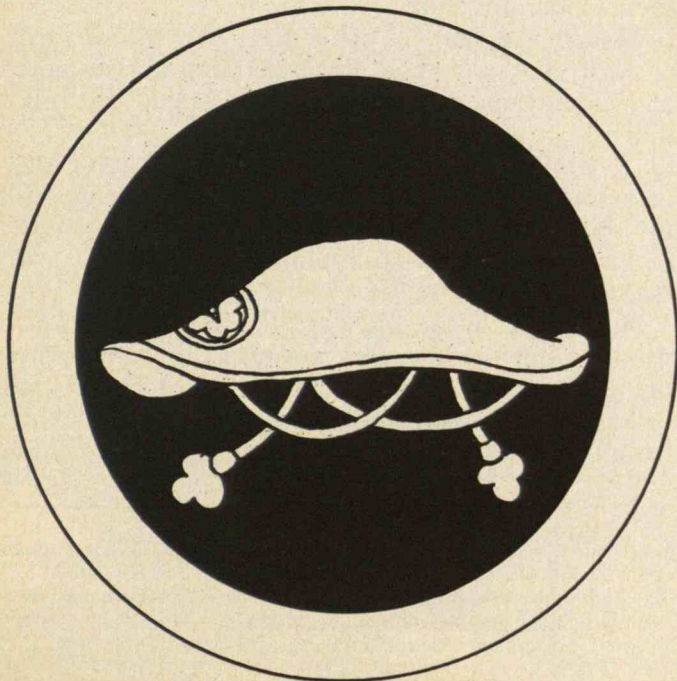
Japanese managers delegate as much work as possible to subordinates to save time for constructive planning and handling of complex situations. In Western business the mastery of supervisory techniques is commonly used as a measure of leadership. In Japan a supervisor is judged by the expertness of his staff and the organization of their tasks.

How Businesses Are Organized in Japan

The fundamental organization of Japanese businesses is quite different from that in the West. In Japan the boss's work is considered to be at same level of importance as any employee. For example, at Nippon Steel, one of the world's largest steel companies, each worker is told repeatedly that his work is as important as any other employee's.

Nevertheless, there is a definite structure and hierarchy in Japanese businesses. Subordinate fac-

“We are
one big family and
have no need
for
such things as
time sheets, time clocks
and
labor unions.”



tory personnel are organized into work teams under managers called “directors”; the ranking of lesser employees is somewhat ambiguous. Top management is composed of the highest-ranking directors, leading up to director, president, and chairman of the board. The company president and the chairman of the board, like emperors, hold almost symbolic positions; they have only the responsibility of correctly judging trends to assure future prosperity.

Functional responsibility, control, and direction usually rest with the managing directors. The actual operating executives of the firm — those in direct charge of the company — are senior managing directors or managing directors. The vice presidents are largely concerned with political and social relations — representing the firm to outside organizations. Internally, they are concerned only with personnel and manpower development.

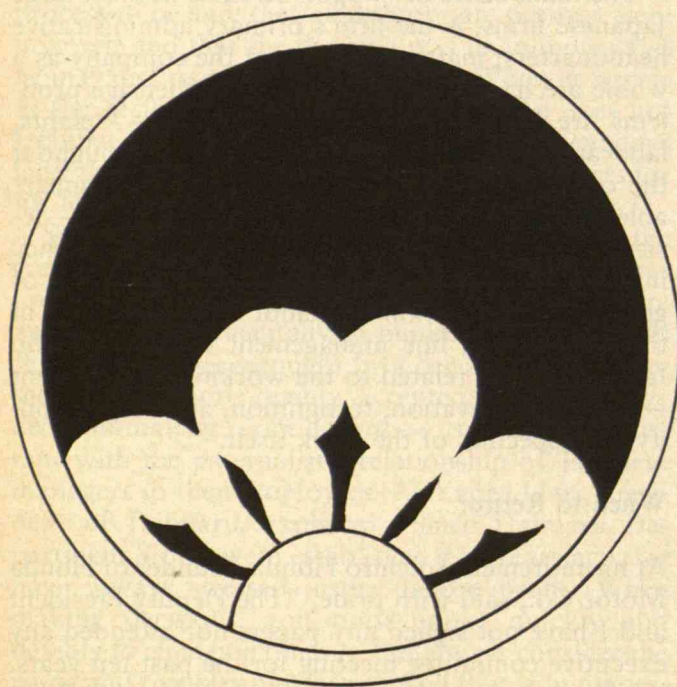
One former board chairman is given the title of director and senior advisor, signifying he has retired with honor. This practice is calculated to give lesser employees the feeling that retirement means security: “Even the chairman of the board retires: why not me?”

Auditors are always employees of a Japanese company. This is a reasonable relationship since the rules governing finance and legal areas in large firms are substantially less demanding in Japan than, say, in the United States.

The main office of Nippon Steel, as in most large Japanese firms, is the firm’s primary administrative headquarters; matters concerning the company as a whole are handled there. Less comprehensive problems are handled at the “works” level — plants, laboratories, and sales offices scattered throughout the country. In this way diversification is manageable and ambiguous horizontal organization — desirable in Japan — is maintained. Personnel policy involving advancement and pay is in the hands of general administration and labor relations people in the main office; line management concentrates on factors directly related to the working environment — worker motivation, recognition, and responsibility, and specifics of the work itself.

When to Retire?

At his retirement Soichiro Honda, founder of Honda Motor Co., said with pride, “The Deputy President and I have not signed any papers nor attended any executive committee meeting for the past ten years. We have done what presidents should do: we have



spent our time correctly judging future trends. That is our job. The details of daily operation we leave to the responsible personnel. They make consensus decisions, and we always approve what they ask to be done for short-term tasks."

Mr. Honda summed up the accomplishments of his organization: "Our business has expanded and good successors have been developed. In 20 years we have grown up from a small garage operation to the world's leading motorcycle company. For the past five years we have been producing cars. Now we can retire in peaceful states of mind, because without us, Honda Motors will operate just the same."

Why did Soichiro Honda quit his presidency after 25 years of successful operation? At the age of 66, Mr. Honda came to the conclusion that the best thing for his company would be for him to quit and let younger people take over, giving five reasons for his decision:

- ☐ A business enterprise should belong to society. He even doubts that Honda Motors should have been named after him.

- ☐ No relative of a president or a vice president ever worked at Honda Motors, so that his family remained a separate responsibility. In retirement he no longer has to choose between loyalty to the company (*ie*) and loyalty to family and kin (*namae*).

- ☐ Also, he said, "I lost my sex power. I don't say I have lost all my sex, but, I must admit, frequency of doing and recovery have not been the same as when I was young. Great leaders love sex, and I am not a great leader anymore."

- ☐ Fourth, he said, "I can't drink any more. Two cups of sake is enough. For entertaining customers and employees, presidents should be able to drink more."

- ☐ And fifth, "I know what I can't do. I don't understand data processing and electronics. Today, automobiles require automation. I am too old to study computers; I have no willingness to learn new technology anymore."

He summed it up this way: "Without sex power, drinking habits, and work desire, I should quit the life of an entrepreneur. . . . I want my employees to be happy. If I had any more to say, I would not retire from the company."

Mitz Noda is a Senior Staff Engineer at Hughes Aircraft Co. He graduated from Hiroshima Technical College and received his B.S. and M.S. degrees in engineering from U.C.L.A. He lectures on Japanese management techniques and has written two books, *Work without Fear—Japanese Management Practice* and *Secrets of Japanese Executives*.

"Where's the best fishing in the Gulf of Mexico? Just look for an offshore oil platform."

"If you have any doubts, ask one of the men who run sports fishing boats in the Gulf," says H. E. Braunig, a Manager of Environmental Affairs at Gulf Oil. "When they want to guarantee their customers a good day's fishing, they head straight for the oil platforms."

"Twenty universities and thousands of fish say oil platforms don't hurt the environment."



"What happens around the bottom of the oil platforms is ecologically identical to what happens around any natural reef."

"A food chain starts. Mussels, anemones, starfish, anything that likes to live on a solid underwater surface, all come first. Then the fish that feed on them; and so on, until a whole ecosystem builds up."

"Even with the oil platforms, it's life as usual in the Gulf of Mexico — even for the commercial shrimp and oyster fishermen, whose livelihood depends on clean water."

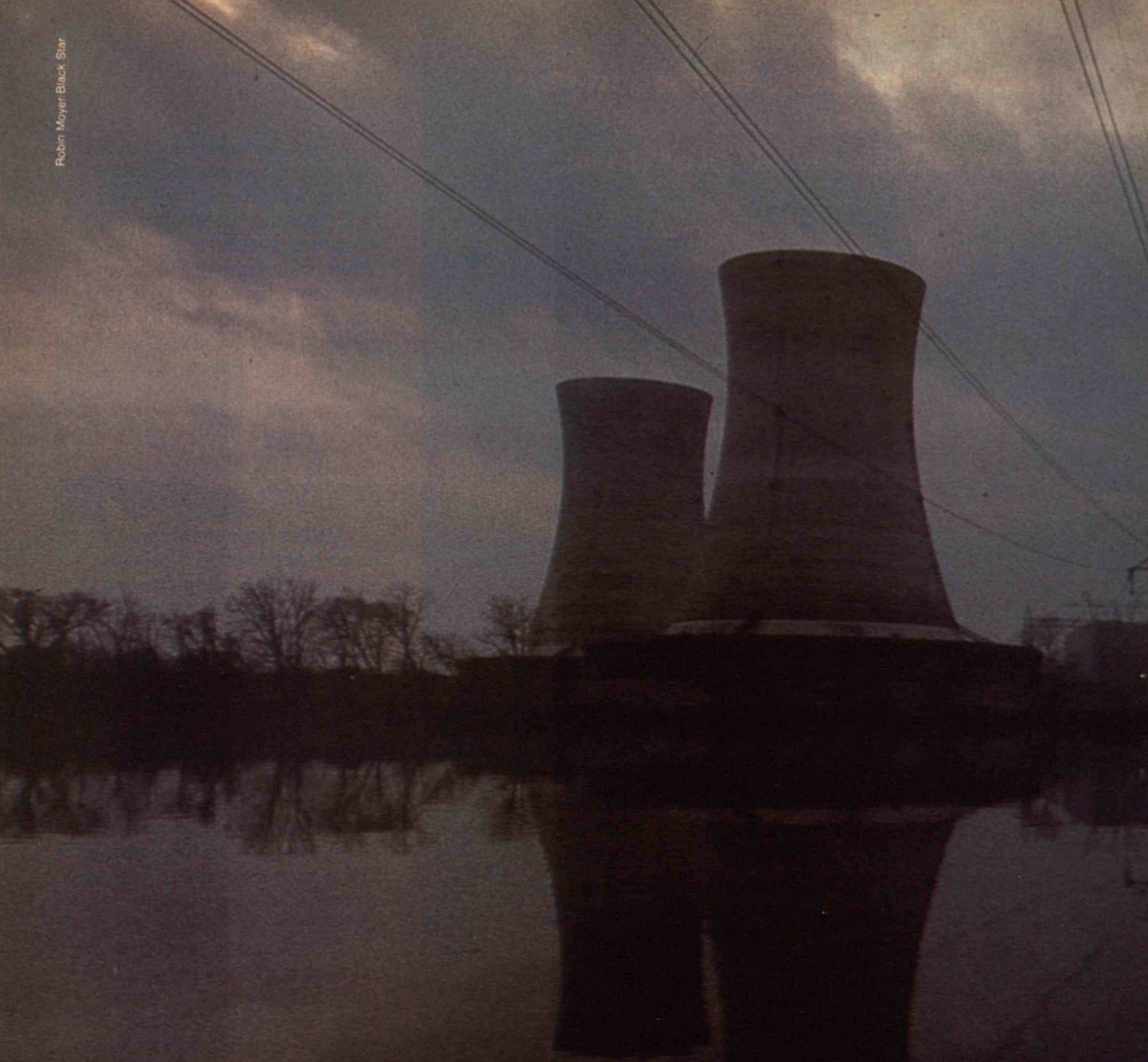
"That's living proof that offshore platforms aren't ecologically destructive. A two-year study by twenty Gulf Coast universities, concluded in 1974, says the same thing."

"Gulf people are meeting a lot of challenges in getting the oil out while preserving the environment. This problem just seemed to solve itself; and with continual environmental monitoring and sampling, on all current and future offshore sites, we intend to make sure it stays solved."



**Gulf people:
meeting the challenge.**

Gulf Oil Corporation



On April 19, 1979, *Technology Review* met with four distinguished experts to discuss critical issues in the nuclear power controversy. Originally scheduled during early March, the meeting was given an entirely new — and concrete — dimension with events that started at Three Mile Island on March 28. The participants were:

□ **Norman C. Rasmussen**, head of the Department of Nuclear Engineering at M.I.T., who directed the U.S. Nuclear Regulatory Commission's study of accident risks in nuclear power plants and was principal author of the *Reactor Safety Study* (N.R.C. WASH-1400, October 1975) — the "Rasmussen report."

□ **Joel Yellin**, Associate Professor of Social Science in the M.I.T. School of Humanities and Social Sci-

ence, who is a physicist, analyst of national health and safety decisionmaking, and prominent critic of the "Rasmussen report."

□ **Daniel J. Kleitman**, Professor of Applied Mathematics (and, as of July 1, head of the Mathematics Department) at M.I.T., who was one of the reviewers of the nuclear risk-assessment methods adopted for the "Rasmussen report."

□ **Richard B. Stewart**, Professor of Law at Harvard Law School, an expert on administrative law and a trustee of the Environmental Defense Fund.

Technology Review was represented at the meeting by **Steven J. Marcus** (Managing Editor) and **Leonard A. Phillips** (senior member of the Board of Editors).

An edited transcript of the discussion follows.

Nuclear Power: Can We Live With It?

A panel discussion on nuclear risk, the lessons of Three Mile Island, and the future of nuclear power.



Risk Assessment and Three Mile Island

MARCUS: Risk-assessment methods (such as those on which the "Rasmussen report" is based) have been criticized for their basic inability to enumerate all possible nuclear accidents. Moreover, even for the accidents that have been envisioned, variables which are difficult to quantify have rendered their probabilities "uncertain."

A preliminary report from the Nuclear Regulatory Commission has listed six major errors that contributed to the recent incident at Three Mile Island: (1) failure to keep spare auxiliary feedwater pumps on line (in violation of N.R.C rules); (2) failure of a relief valve to close; (3) a faulty water-level indicator; (4) a radioactive leak prevention system

which didn't work; and (5 and 6) human errors committed by technicians who turned off the emergency and primary cooling pumps.

Was Three Mile Island a "predicted" accident? And if so, does its occurrence cause any probability estimates to be revised?

KLEITMAN: I just looked over the "Rasmussen report" yesterday to see what kind of predictions it made of this sort of thing. I was surprised to find that it did a pretty good job. The equipment failures at Three Mile Island, in fact, were predicted to be quite common. That is, "transients" were assumed to occur roughly ten times a year. [A "transient," in nuclear jargon, is any event — planned or unplanned — that calls for shutdown of the nuclear power plant.]

RASMUSSEN: Yes, three times a year for feedwater pumps and seven for other reasons.

KLEITMAN: Given the transient, the next thing that happened was a valve opening and then failing to close. Now I find in the report a different figure for the probability of this failure in each of the two kinds of reactors — boiling water and pressurized. In the former, there was one chance out of ten that this valve would fail. For the other it was one in a hundred. In both cases, probability errors were a factor of ten. That means if transients happen ten times a year, you would expect that kind of accident on the average at any reactor once every five years. And, taking the country as a whole, you would expect such a valve failure to happen quite often, because we have quite a number of these reactors.

YELLIN: Yes, that was one of the most common initiating events the WASH-1400 study group predicted. But my concern is: how do you assign a probability to a failure in which someone shuts the valves of all three auxiliary feedwater pumps, and then leaves them closed for days?

KLEITMAN: The group simply predicted that reaching that point (with the valve opening and then failing to close) — regardless of how it is reached — brings you a small loss-of-coolant accident.

RASMUSSEN: In the plant we looked at — a Westinghouse plant — you do not open those valves unless both the feedwater and the auxiliary feedwater fail [see figure on page 38]. With a large steam generator and a lot of water capacity, the transient is not felt in the primary system until you boil the steam generator dry. And that takes half an hour to an hour. For the case we looked at, therefore, what Dan said isn't right, because you have a low probability of failing — you have an hour or so to get the feedwater back on, if it didn't come on when you pushed the button. In a Babcock and Wilcox plant [e.g., at Three Mile Island], that is not true. Every transient that stops the feedwater relieves the primary system valve. In that sense, Dan is correct. At Three Mile Island, they got it on in eight minutes and they were still in some trouble.

YELLIN: There is an important point here we should emphasize: the designs of different reactor

manufacturers have different safety implications. So by analyzing one particular design you cannot anticipate a sequence of events specific to another design.

RASMUSSEN: That's right. But the classes of events — the failure of the feedwater, the failure of the auxiliary feedwater, the valve opening, the valve failing to close — were all considered in WASH-1400 in a general way. No analysis like this will include every little occurrence. It shouldn't be viewed that way.

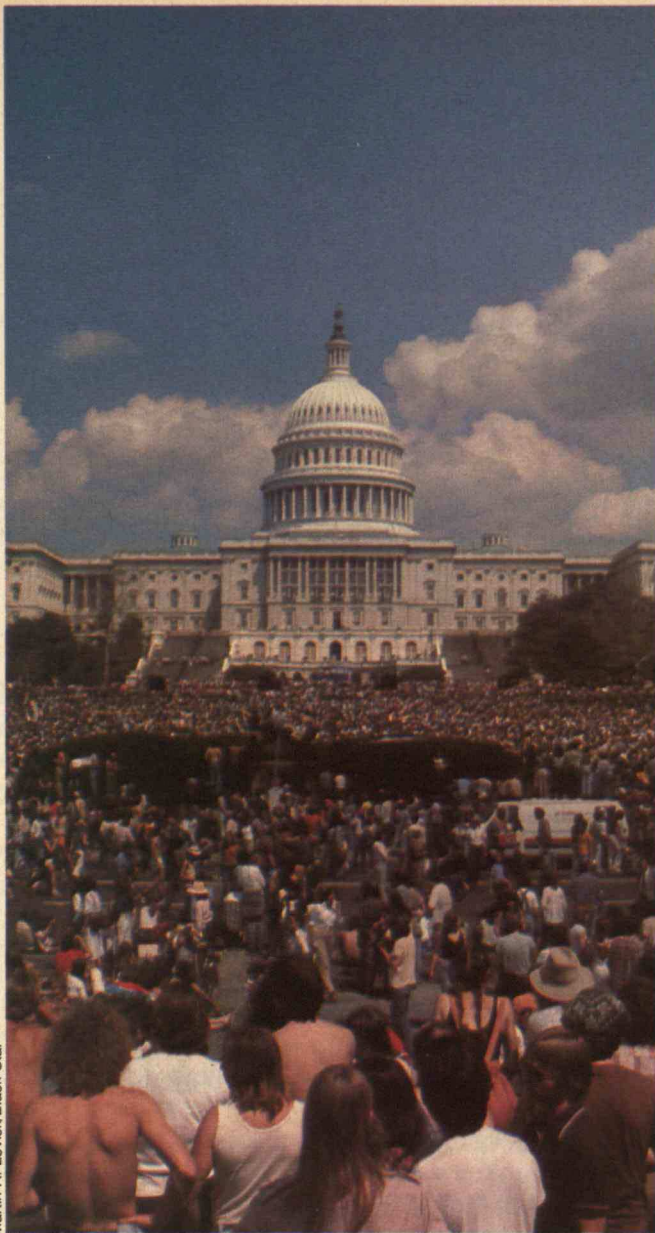
YELLIN: There's a further implication of these differences in design. There are four major reactor manufacturers in the United States, and one should be very careful about lumping the reactor operating experience of all four together — as has been done in the past — and then talking about an "actuarial" upper limit for the reactor failure rate of the entire nuclear industry. The Three Mile Island accident suggests that we should perhaps disaggregate the information we have about reactor experience and talk about a separate failure probability for each manufacturer's plant. Considering each design separately, the operating experience we have is pretty thin. If we disaggregate, the probability of catastrophic failure (in an actuarial sense) has a rather high upper limit, on the order of 1 per cent per reactor-year for the larger manufacturers.

MARCUS: Professor Yellin, haven't you written ["The Nuclear Regulatory Commission's Reactor Safety Study," *Bell Journal of Economics*, Spring 1976] that risk could vary a thousandfold or more, depending on the site, using the Rasmussen report's methodology?

YELLIN: Yes. But here we're talking about "in-reactor" failures, and there I was speaking of failures in which a large amount of radioactivity is assumed to be released from the containment.

KLEITMAN: The report concerned two specific reactors. You have to be careful if you extend those conclusions to any other reactors — even by the same manufacturer at different sites.

YELLIN: We should discuss "human error," too. A couple of weeks before the Three Mile Island incident, somebody there evidently turned off three sets of valves, disconnecting all three auxiliary feedwater



Martin A. Levick/Black Star

pumps. These simply were not connected into the system, in violation of N.R.C. regulations. Now you discussed that particular possibility, Norm, in WASH-1400, and ascribed a probability of three per 100,000 reactor-years to it. But if one looks closely, it appears there really was no specific reasoning used to reach that estimate. Your report just says there's a 1 per cent chance that one pump will fail. And it goes on to say that because somebody else might walk around, inspect the valves, and discover that all three sets were closed, the total probability of failure comes to three in 100,000 reactor-years. No justification is given; it's just a number that's thrown out.

RASMUSSEN: That was an assessment by a human factors person. It was his expert judgment.

YELLIN: But it had nothing to do with any particular risk evaluation process given in WASH-1400. It was a "subjective" judgment.

RASMUSSEN: Well, among other things he reviewed the kinds of failures that had been happening

in nuclear plants to get his estimates.

YELLIN: But looking now at the Three Mile Island event, and knowing that this particular failure did occur in hundreds of reactor-years, not tens of thousands, one should at least raise the question whether that was a sensible method for evaluating such probabilities.

RASMUSSEN: No. The method, Joel, was to look at our experience — how trained operators and maintenance men had performed — and then try to estimate how often they make the kinds of failures that create a situation like this. And I don't see anything wrong with that method. Three Mile Island gives us another data point, for sure, but I don't think you would argue that looking at previous experience isn't a fair way to estimate that kind of happening.

YELLIN: But is it, in fact, sensible to ascribe certain probabilities to human errors of this kind? I don't think one can really describe such failures with a single number.

RASMUSSEN: But you can't do any comparisons, Joel, if you don't put a number on it.

YELLIN: I don't see how you could argue, given the Three Mile Island experience, that this number was meaningful.

RASMUSSEN: But rare events do happen. You get four aces once in a while; you get a straight flush once in a while. One occurrence doesn't mean that this isn't a rare event. On the other hand, it surely warns you that the event might be a lot more frequent than you first thought.

YELLIN: We aren't discussing a pack of cards. If mathematical language is in order (and I'm doubtful that it is), we're discussing a multi-dimensional "system" comprised of human beings who are supposed to be doing many different things, and I question whether it makes any sense whatsoever to describe numerically the chance such a "system" will fail. You can, of course, say the failure probability is "high" or "medium" or "low," but why pretend to precision that doesn't exist?

KLEITMAN: One reason a single number has limited usefulness is that the probability of human error depends a lot on the training and the ability of the people involved. And that, by the way, is a function



The Red Cross Evacuation center in Hershey, Pennsylvania.

of the probability you assume. If a hazard seems to be something very rare or unimportant, nobody pays much attention and nothing much in the way of training is done about it. On the other hand, errors considered common or serious are likely to be prevented with appropriate training.

RASMUSSEN: But in *WASH-1400* we assigned distributions, not specific numbers. In each case there was a range, and 95 and 5 per cent bounds, and the errors were propagated by Monte Carlo methods [i.e., a random number from the assumed distribution was used, the process was repeated many times, and the results were averaged].

MARCUS: This was specifically on human factors?

RASMUSSEN: Sure. Everything that was multiplied together was done that way.

YELLIN: That is not totally correct. In some important instances, it was just assumed that there was no uncertainty at all, and only a single point value was used. An example is the estimate of the probability of containment failure.

RASMUSSEN: No, I don't think that's true.

YELLIN: Well, it's true, Norm. I had detailed discussions with the N.R.C. staff director of your study, Mr. Saul Levine, and he made it very clear, in writing, that the error propagation process you describe was not used for containment failure probabilities. That's one aspect of a general understatement of uncertainties in *WASH-1400* that also extends, for example, to the genetic effects calculations and to control rod failures in boiling water reactors.

RASMUSSEN: We used a probability distribution for the likelihood of containment failure — 10 per cent chance of failure at a certain pressure, 50 per cent at another pressure, and so on — but we did not assign an uncertainty to that distribution. We did assign an uncertainty range to genetic effects, although it may not be as large as you feel it should be.

YELLIN: What was done in *WASH-1400* was to use a single point value for the probability that a steam explosion failed the containment. Though *WASH-1400* explicitly states that an error propagation process was used to quantify the containment failure probability, Mr. Levine wrote to me that

"*WASH-1400* did not include the uncertainties in all the containment failure mode probabilities since the detailed error spreads and associated probability distributions were not accurately quantifiable by the engineers." So even though containment failure was admitted to be a highly uncertain matter, the uncertainty in effect was set to zero, as though it were perfectly certain. The point estimate was just multiplied into the rest of the "fault-tree" calculation.

RASMUSSEN: That's true for the steam explosion.

KLEITMAN: I wanted to say a couple of more words about the Three Mile Island accident. The sequence up to the point of the valve sticking open, I think, was predicted by the Rasmussen report to happen fairly often. What went on after that was not. That presumably was "human error" — people turned off the water systems. And that action, I think, was included in the report's probability of human error (somewhat unspecified) of about one in a thousand.

RASMUSSEN: Well, we had several types of human errors.

KLEITMAN: But it seems to me that the "errors" made at Three Mile Island are a little difficult to understand. How you could turn off water in a situation like that, I just don't know.

YELLIN: We're not even sure, at this point, what the facts were in that accident.

RASMUSSEN: Well, we certainly know that the operator turned off the emergency cooling water at one point in the event. Why he did it, we have no idea. Perhaps he was getting wrong information from his control panel.

Health and Economic Impacts

KLEITMAN: Now what about the spectrum of consequences that come from such trouble? They could range from "very little" to a real disaster. It seems, from the present vantage point, that the human safety and health consequences of the Three Mile Island event are relatively small. There are single automobile accidents, for example, which cause a lot more damage to human beings. Thousands of these occur each year. On the other hand, there are other

damages from a nuclear accident, such as the economic damage, which may be significant. Just what's going to happen to the plant? That's a factor which was not present in the WASH-1400 analysis, and it may turn out to be quite important.

RASMUSSEN: We deliberately did not try to assess how many dollars' damage to the plant would result in these events. Our aim was to look strictly at the direct effects on the public — damage to public property and to public health.

KLEITMAN: Yet it seems to me that the extensive economic damage to the plant itself may well be the greatest loss.

RASMUSSEN: Certainly over \$100 million loss, maybe even more, were incurred at Three Mile Island. It is insured for property damage up to \$300 million. And there is another economic impact, too. Nuclear is a relatively cheap power source, and when it's turned off you replace it with something more expensive.

YELLIN: I don't agree with the implications of that statement. Given any base-load power source which is regularly relied upon, suddenly replacing it with another source is going to cost a premium. That is not evidence, in itself, that nuclear power is cheaper.

MARCUS: What about the effects of the Three Mile Island incident on the local and regional economies? With significant slow-downs in production and business activity for several weeks after March 28, I wonder what happened to the "gross regional product."

RASMUSSEN: I doubt if that loss is as much as the additional income they'll get from all those people working there for the next year or so.

YELLIN: I don't think we're talking about an enormous direct economic effect on the population around that reactor. The biggest economic damage is going to result from the damage to the plant and the repair of that damage. But just who will bear the financial burden is not yet clear.

RASMUSSEN: As I mentioned before, the first \$300 million worth is covered by a property damage insurance policy.

PHILLIPS: I'd like to bring up the subject of *liability* insurance. Doesn't the Price-Anderson Act limit the



Robin Moyer/Black Star

liability of the utility to about \$560 million to the public in the event of a nuclear accident?

YELLIN: No, that's the total limit of aggregate claims that can be collected. It's not necessarily the liability limit of the utility itself.

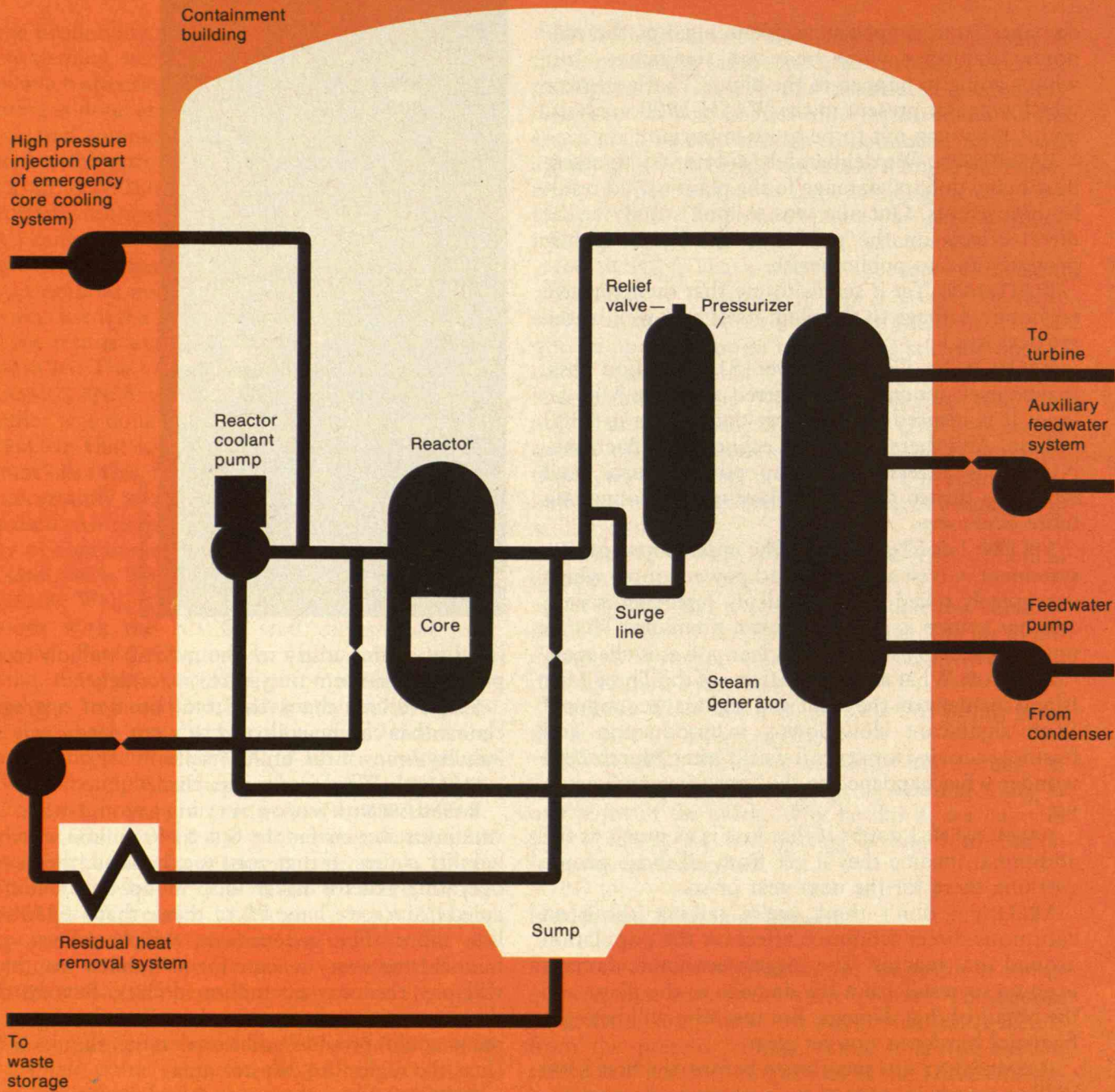
PHILLIPS: What is the gap, then?

RASMUSSEN: It's not a very big gap any more. Private insurance covers the first \$140 million worth of liability claims. If that pool is exhausted, then every operating reactor must kick in up to \$5 million apiece. Since we have 70 of them, that's \$350 million more. The government, which collects premiums from every reactor for its liability insurance, will pay the next 60 million dollars. Beyond that there is no insurance policy, but the federal government could provide additional relief should it declare the region a "disaster area."

PHILLIPS: Given that process and the limitations of that process, do you think it's adequate protection for the public?

RASMUSSEN: Well, yes. It's not the ordinary kind

A partial schematic illustration of the reactor and its peripheral systems



of insurance — not the kind that's carried by anybody else — because it's no-fault. You notice that at Three Mile Island, for example, the insurance company paid everybody that had a child and was asked to leave. All you had to show was that you incurred the loss and that it was due to this event. But it's different with other kinds of accident insurance. Suppose, for example, that there's another ship explosion in the Texas City harbor. You don't have no-fault insurance there. You must prove who is at fault and collect from that party. There's a long legal process involved.

STEWART: The courts are moving more toward a principle of strict liability (for the source, or primary cause, of an accident of this sort). I think you're quite right that there could still be a lengthy process of litigation — involving proof-of-damage questions, for example — but I think the system as it operates now is becoming more streamlined by eliminating proof of fault or negligence.

RASMUSSEN: I looked at a case, during the Vietnam War, where a munitions train blew up and destroyed a small town out in California. A number of years after the event, nobody had been paid because the government said it was the railroad's fault and the railroad said it was the government's fault. And it's that kind of thing that you don't run into in nuclear cases. The insurance company certainly has the right to try and collect what it paid out, if it can prove someone liable, but the company must promptly pay out the claim to the injured party.

YELLIN: Let's be careful here, because the Price-Anderson Act contains no waiver of the burden of proof of causality faced by anyone who claims he or she was injured by a reactor accident. That can be difficult to establish in ordinary tort cases and would be difficult in nuclear accident cases as well. We will have some examples eventually. Suits will no doubt be filed by people who live in the vicinity of the Three Mile Island plant — for example, on behalf of a child who gets leukemia in the next few years.

RASMUSSEN: We don't have an argument on that. You do have to show that you have the loss.

YELLIN: I want to make this clear. It may be that there is a causal connection, but that may be very

difficult to prove. The case law — in particular, cases in which it is asserted that an event which happened years ago has resulted in cancer — does not come down on the side of people who believe themselves injured.

STEWART: If you compare nuclear power to other forms of supplying electricity, especially coal, that problem exists as well. In the coal situation, where you're dealing with emphysema or cardiovascular disease, attributing causality to a specific source is really impossible because it is a generalized air pollution problem. The burden of causality is so great that so far there's been no successful court-ordered recovery.

PHILLIPS: But suppose a precedent were set, ten or five years from now, with causality being upheld in the courts. Suppose cases of leukemia, or other forms of cancer, were linked with the release of radioactive materials from Three Mile Island. Should that happen, wouldn't the utility become liable as the limits of Price-Anderson were exceeded?

YELLIN: No. The law specifically says the utility is not liable for damage beyond its private insurance coverage. However, in this particular instance the limit's not going to play a role because there just aren't enough people involved, and there apparently are no dramatic injuries. While a number of class action suits have been filed, each claiming \$560 million, it's doubtful that the total damages eventually awarded will exceed the Price-Anderson limit. But if you change your question, suppose that there had been a breach in the containment because of a hydrogen explosion and a lot of radioactive material escaped, and suppose further that people had not been successfully evacuated, then hundreds of thousands of people might have been dosed heavily. Then your question begins to cut, because we may observe in five or ten or twenty years an increase in the incidence rates of certain cancers. That would result in lots of litigation, and if damages were awarded they could be large enough to exceed the Price-Anderson limit. The federal government would have no legal obligation to take care of the excess claims. But the way Price-Anderson is written, the government would have a "moral" obliga-

Joel Yellin

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tion, as Norm suggested before, to use the "disaster area" mechanism to justify additional relief. Whether Congress would in fact provide such relief is unclear. The history of federal disaster relief in some instances is not encouraging.

STEWART: My environmental friends often argue against the Price-Anderson Act, claiming it's a subsidy to nuclear power. But in fact the legal system subsidizes coal even more. If we rely on epidemiological data, people are suffering morbidity and mortality from coal combustion all the time, and yet that cost is not internalized to the operators of coal-fired power plants.

RASMUSSEN: And government subsidies to miners who get black lung disease are also not included in the cost of coal.

MARCUS: There's something not quite right about these comparisons. The fossil-fuel "subsidies" seem to deal with routine and largely preventable problems. Strict enforcement of mine safety and pollution control regulations could dramatically reduce that mortality and morbidity. But Price-Anderson only applies to the results of a rare but devastating event. Isn't there a substantial difference?

STEWART: Do we distinguish dramatic harm, that occurs in a conspicuous fashion, from continuous lower-level harm? Certainly the public and the politicians assess them very differently. I guess the second point you're trying to make is: To what extent is the damage reducible through preventive measures? I guess in both cases you can reduce risks. You can put scrubbers on coal-fired plants, or install, eventually, a fluidized-bed combustion system, and thereby reduce the discharge of pollutants. I assume that with a nuclear plant you could have more redundancy, and more monitoring, to reduce risks.

But maybe, you say, there's still an irreducible probability of a serious event in the nuclear case that is qualitatively different from the risks of coal.

RASMUSSEN: There are large events possible to imagine with coal. A CO₂ buildup may increase global temperatures and the polar ice cap could begin to melt. That would raise the levels of the oceans and affect many coastal cities. Surely it would happen slowly enough to permit evacuation, and thus prevent loss of life, but it would disrupt society greatly in terms of loss of property.

YELLIN: Maybe an even better analogy is a possible accident in an LNG tanker. If one ignited in Everett [Mass.], for instance, it has been suggested that a lot of people could be harmed.

RASMUSSEN: I think an even better one is a major dam failure. I've looked some at LNG, and — although you can have serious accidents — I don't think they're of a magnitude substantively greater than one caused by a large gasoline tanker. There are a few exceptional scenarios you can imagine: if the gas doesn't burn immediately but covers a large area and *then* burns. But there are so many ignition sources in any populated area it's hard to imagine how that could happen, especially since the gas always moves with a leading edge that's in the combustion range.

YELLIN: Do we have any example of a dam which sits above a really heavily populated metropolitan area? Which is the worst one in the U.S.?

RASMUSSEN: Well there's some in California, Joel — earthen dams in earthquake country — that have 100,000 people exposed in a kind of narrow valley that leads out from the dam.

YELLIN: The question of population exposure is also crucial with respect to nuclear plants. There are

some existing reactor sites in this country that would presumably never be approved now, because of high-density population nearby. Indian Point (N.Y.) heads the list, along with Zion (Ill.). In the most unfavorable meteorological conditions, an accident at either of those two sites would have very grave consequences.

Contamination

MARCUS: Professor Rasmussen, granted that there is possible, with every option, a spectacular and massive accident, perhaps you can give me some perspective on one aspect of a serious meltdown accident that seems to be without compare. This is the potential for long-term radioactive contamination of a fairly large area of land. Given the financial resources, people could rebuild what a broken dam had washed away or what an exploding LNG tanker had burnt down. But in the aftermath of a serious meltdown, wouldn't it be a very long time before the surrounding area could be safely inhabitable?

RASMUSSEN: If you don't do any cleanup, there would be an area that you wouldn't inhabit for a long time. But of course it depends on how badly you want to get back on the land. If you want to invest money to clean it up, you could do it. If it's highly contaminated, of course, it's very expensive. You can get a decontamination factor of 20 or so by modest — but not cheap — methods, and that would reduce the uninhabitable area substantially. But where you needed a factor greater than 20 you'd have to go to very expensive means to clean it up.

YELLIN: There's a lot of disagreement about how much it would cost, and how feasible it is, and how large an area you could clean up. I'm not quite sure what methods you're thinking of, Norm. Coming through with bulldozers and taking away the topsoil?

RASMUSSEN: No, no. For much of the agricultural land you just need deep plowing. But I'm thinking of washing a residential area with fire hoses and maybe, if there are hot spots, taking up some pavement here and there.

YELLIN: Let me just respond to that, for it is by no means clear that washing with fire hoses effectively gets you even a factor of ten. Your study, I think, overstates the case for that. The effectiveness of decontamination depends rather sensitively on the size of the particles you're trying to remove, and the small particulates released in a reactor accident will surely make things difficult. The evidence for the ef-

fectiveness of decontamination methods just doesn't seem very good.

RASMUSSEN: I'm not an expert on decontamination, but we depended on the people at Sandia — a group that's had a fair amount of experience.

MARCUS: Professor Rasmussen, your report stated that in the event of a meltdown almost all of the solid radioactive material would effectively be contained by the soil. I wonder if there are alternative opinions on that. Certainly the popular idea of a "China syndrome" — the melted fuel burrowing into the ground, hitting the groundwater table, and then spewing forth — poses an altogether different image. Also, even if the land-as-filter conception were correct, wouldn't there still be some long-term damage, such as groundwater contamination?

RASMUSSEN: If something melts into the ground it doesn't hit a lake down there. It just hits wet soil, with water in the interstices. So you don't get the kind of phenomena that lead to steam explosions such as we considered in the reactor containment itself. The soil does provide a good heat sink and gradually it solidifies the melted mass. The gaseous elements diffuse out to the top of the soil, and the elements like cesium get bound up because soil is a very effective ion-exchange medium. Now the water comes along, dissolves some of the material, moves it a little, and it gets retrapped. So you have a process that moves the radioactivity through the ground, but the rates are very slow. Like meters or maybe tens of meters per year, and sometimes much slower. Therefore, you have time to institute measures to contain the radioactivity before it gets away from you.

YELLIN: There's controversy about this particular point — whether or not thorough shielding is provided by the ground around the reactor. The American Physical Society (A.P.S.) report, which reviewed the draft version of *WASH-1400*, raised the possibility that there could be fissures in the ground and that some material would escape. The A.P.S. group decided *WASH-1400* was very liberal in assessing a shielding factor of 100 due to ground filtering. That's not a settled issue.

Disaster Management

MARCUS: What about the airborne radioactivity from a meltdown accident, and keeping local populations out of its way? *WASH-1400* assumes "dispersion models" will predict the path of the radioactive plume and, accordingly, that successful



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evacuations will be devised. But experience in air pollution work, including my own, suggests that such models can be notoriously inaccurate. Therefore I wonder how well people can be removed from the danger. The situation at Three Mile Island was described by *Science* this way: "It was impossible to find out how well-defined the evacuation plans were because they were being kept confidential until the moment they might be needed. The reason for this [a Pennsylvania official explained] was that the plans shifted every day with changes in the wind. Giving out details prematurely might lead people to follow the wrong escape routes." This underlines the enormous difficulty of predicting which direction, if any, is best for evacuation.

RASMUSSEN: But you do that by measuring the wind direction when you issue the evacuation plan.

MARCUS: It isn't that simple. Most dispersion models assume a unidirectional wind and a featureless plain with no surface irregularities. But real situations produce very complex wind patterns, usually resulting in turbulent, uniform mixing. So in general you won't get this nice, well-behaved "plume" but a much more uniform distribution of "pollutant." And this seems to reduce to absurdity any idea that people could get out of its way. But even if it were possible to predict the most desirable evacuation routes, I still wonder about the psychological "impacts." How do you get large populations to accept, and live with, institutionalized evacuation plans?

RASMUSSEN: Do you know how many evacuations we have in the United States every year? They are not rare events. Since the Three Mile Island accident, we've evacuated five or ten thousand people in Florida. We now have about twenty thousand people under evacuation in Mississippi. We do it almost every week. It's not an unusual thing. I admit that it is unusual to do it for radiation, and that it may create a special psychological problem. But we evacuate people without plans all the time. That is, we have plans of who should initiate it and take the responsibility, but there generally are no plans for evacuations like the one in Florida — where a train derailed and poisonous gases were released from one

of its tank cars.

MARCUS: But that's a different set of problems. Who can say where the train will be and where it will explode?

RASMUSSEN: Nobody can say. So we have a little edge in the nuclear case because we know what region is likely to be impacted. Therefore we know where the people are that we may have to move, if we have a problem in a nuclear power plant. This certainly helps in the planning.

YELLIN: I don't think, by the way, that the question of uncertainty with the dispersion model has very much to do with the efficiency of evacuation. It seems to me — and Norm took a similar stance in his report — that if you have warning you can start moving over a rather large area. But even though we do move people fairly frequently, we have very little experience moving people in numbers greater than 100,000. There may be two or three precedents, but they don't get much beyond 200,000 and they aren't terribly analogous to the kind of evacuations we're discussing. Let me also say that a very recent report by the General Accounting Office — which by coincidence appeared a few days after the Three Mile Island incident — criticized the very inadequate nature of evacuation plans for the areas around commercial nuclear reactors. Planning for reactor accidents is not in good shape. It deserves a lot more attention.

KLEITMAN: With regard to your initial question — What have we learned from Three Mile Island? — certainly the need to improve coordination, for such things as evacuation plans, is one of the most important lessons. Apparently the people who had to make decisions were not apprised very early of what was going on. Now a second thing, changing the subject slightly, is that it has always been folklore that the people at utilities are . . . sometimes not too bright.

YELLIN: Are you going to give us some evidence for that?

(Laughter)

KLEITMAN: Apparently there is some evidence. The situation at Three Mile Island was at best a comedy of errors and almost became a tragedy of er-

rors. Just about everything they did was wrong, according to reports so far.

MARCUS: I recently read of Alvin Weinberg's suggestion that we create new entities for managing the nuclear option: that it be done exclusively by people whose only business is nuclear power (unlike most utilities, which produce power in a variety of ways); and that the people who run the plants essentially be an elite Mandarin class — paid very well (at \$100,000 or so a year) and with training, experience, and knowledge comparable to that of a 747 pilot. But even assuming such super competence and the most modern and efficient techniques for managing an accident and executing evacuations, wouldn't this still be an unacceptable psychological burden for the populations involved, in the wake of Three Mile Island?

KLEITMAN: I'm not sure it's necessary to go quite that far in terms of training. In answer to your question, in some sense people live with that kind of thing all the time. If you live in various parts of the midwest, there are tornado dangers that seem more probable than the reactor dangers.

RASMUSSEN: And as dramatic.

MARCUS: But tornados are "acts of God." You can't really do anything about that.

KLEITMAN: You can move somewhere else where they don't have them. People *do* choose to live there.

RASMUSSEN: You can also build your house so it will survive them, but that gets pretty expensive. Also, people in Mississippi rebuild on the same flood plain where, a short time before, they were flooded out. I heard someone interviewed: "It was only five years ago this happened to me." So people deliberately do take those risks in some areas. Whether it's psychologically different from nuclear power, you may have a point. I can't analyze that.

PHILLIPS: Those examples ignore the possibility that some people are forced to rebuild in the same area because they cannot afford to move and build elsewhere. But on a more fundamental level, they shouldn't be compared with nuclear power. Regarding the example of a tornado: that truly is an "act of God," whose risk we all must live with (although some do risk a little more than others). Building a



structure — like a nuclear reactor — that would threaten us, even remotely, is a voluntary thing, however. It is done only after deliberation. It also gets pretty deeply to the heart of a philosophical question: Should we incur even remote risks of this kind if there are alternatives?

Risk "Decisionmaking"

STEWART: That poses a point that we may want to take up. I think we've been talking, to a large extent, about estimating risk in a technical sense. But as a lawyer I'm very interested in our institutional mechanisms for assessing risk and what Three Mile Island may have taught us about how, as a society, we evaluate alternative power sources.

YELLIN: When one proposes to build big risk-creating installations, it's important to consider — from a "hard" technical point of view — the alternatives and their relative risks and benefits. But ethical questions are also raised. Society shouldn't be in the position of having to face the barbarism of intermittent accidents, with communities confronting the realization that every once in a while something which people decided to do could change life profoundly, not only injuring individuals but possibly also destroying the community itself as a social entity. That's quite a different situation from living with the danger of a hurricane or tornado.

RASMUSSEN: Yes, but driving in our cars and flying in our airplanes offers those same risks, Joel.

YELLIN: There are all sorts of risks in the world, Norm. But nuclear power may introduce a new dimension of industrial risk. Over the last 20 years, reactors have been built near where many people live. An accident at a site like Indian Point could have consequences which far exceed those of other 20th century peacetime disasters in the United States. And in your study, Norm, you calculated that after the worst accident at Zion (on Lake Michigan between Chicago and Milwaukee), 30,000 to 40,000 people would die within weeks or months because of high radiation doses [See J. L. Sprung, *Sandia Laboratory report SAND-78-0556*, Oct. 1978, p. 44]. That doesn't include cancer or genetic

disease, and it's a low estimate anyway, given what we now know about making those calculations. I agree that careful risk comparisons need to be done. But before risks can be compared, they need to be evaluated. And I doubt — having now looked at the history in some detail — that potential accidents and their consequences were carefully considered when metropolitan-area sites like Zion and Indian Point were chosen.

STEWART: Perhaps you'd like to tie that into the Weinberg proposal. One way to deal with that, institutionally, is to set up some authority to operate and manage nuclear plants. And that authority would presumably not have the sorts of incentives that utilities may now have with respect to locations.

YELLIN: Weinberg has suggested that nuclear generating capacity be expanded, with more reactors placed at existing sites. My colleague Paul Joskow [Professor of Economics, M.I.T.] and I take a somewhat different tack in recent work: we suggest that if nuclear power is to be pursued, a siting policy with reactors 50 to 150 miles from major population centers is called for. We would retain dispersed siting, however. We're uneasy with "nuclear parks" because of national security and system reliability considerations. Siting policy and its relationship to utility incentives, of course, depends on the whole panoply of statutes and regulations. And I hope that more carefully considered siting laws and regulations will emerge following the Three Mile Island incident.

Regulation

MARCUS: The *New York Times* has listed four "structural problems" of the Nuclear Regulatory Commission, as brought to light by the Three Mile Island incident:

- ☐ Its power to assume control under emergency conditions is ambiguous.
- ☐ The five-commissioner leadership is unwieldy for crisis-condition decisionmaking.
- ☐ Its regulation of the industry's planning and op-



Calvin Campbell

erations are not adequate.

- ☐ There is no well-defined source of technical expertise for providing immediate assistance when an accident occurs.

It is also my understanding that members of the U.S. Senate and House of Representatives intend to introduce legislation, specifically adding more "structure" to nuclear regulation: 24-hour-a-day supervision by a federal inspector; elaborate evacuation plans; and a variety of other things. Now what I want to ask is: What kind of structural changes are needed? — any of these, all of these, or others? And wouldn't they add considerable cost to doing business and possibly threaten nuclear's ranking relative to other options?

YELLIN: The N.R.C.'s Advisory Committee on Reactor Safeguards has suggested one of the obvious alternatives, which is more safety equipment tacked on to plants. That would certainly increase the cost of reactors. Whether it would enhance safety is an open question. Adding further complexity may hinder, not help. Passing a law which says there is emergency authority in the N.R.C. (to take over in case a plant has an accident) is probably not going to change the economics of nuclear power very much. And I'm not sure that having a full-time federal inspector is such a good idea, although it seems to be an attractive political possibility — supported by the president of the United States, among others.

RASMUSSEN: You know why? It was a procedure [Admiral] Rickover used. I'm told that Rickover always had his man in the control room at the Shippingport (Penn.) plant.

STEWART: Of course, the story was that Rickover always said he'd try to make his reactors twice as safe as the civilian ones.

KLEITMAN: With regard to structural improvements, I think something more should be done about training of maintenance people.

RASMUSSEN: Actually, a large fraction of the operators in nuclear power stations were trained in Rickover's program.

YELLIN: I looked into that a little bit, Norm, be-



cause you mentioned it to me before. Some utilities seem to have better training and in some instances a higher percentage of people with nuclear submarine experience. I have a strong sense that there are large differences between utilities in safety practices, training, and maintenance. That's paralleled by similar differences among the nuclear countries of Western Europe and Japan.

MARCUS: What kind of recommendations would you make, then, for addressing some of this variability and for raising the general level of competence?

YELLIN: Obviously, particularly in view of what happened at Three Mile Island, training programs need to be upgraded. The N.R.C. regulatory staff has emphasized the importance of better training, and I hope the commission will follow through. For the long term, however, I don't think we can rely on a sustained regulatory effort to maintain high personnel and training standards for the 40 years for which the present commercial reactors are licensed to operate. The reason more restrictive siting may be in order is that it provides a potential passive means for improving safety — one not dependent on the skills of plant operators, on the cleverness of reactor designers, or on the effectiveness of manufacturers' quality assurance programs. With more remote siting there would be fewer people living nearby, and you could do a much better job of getting them out of the way in the event of an accident.

STEWART: I think we can get hung up on our legalistic, regulatory instincts. The same variations among workers occur, for example, in oil drilling rigs or tankers. Some companies are much more careful and have better trained, better quality personnel than others. It doesn't seem to depend on statutes or regulations. What we need is somebody who can shut the place down if that person is not satisfied that things are operating in a shipshape manner.

RASMUSSEN: Of course, the N.R.C. has the authority.

STEWART: Yes, but the way they currently do

business, I don't think they really exercise it.

YELLIN: You certainly couldn't rely on N.R.C.'s current system for inspection, unless the size of the staff were greatly increased. I think there are only a hundred people or so right now who do that work.

RASMUSSEN: 20 per cent of the plants have a resident inspector, and I think N.R.C. is fairly pleased with the way this has worked. One of the programs proposed — and I expect it may now be funded — is for *every* plant to have a resident inspector. What you worry about is that the inspector becomes so identified with the plant that he becomes a "plant man" instead of a government man. He now begins to defend this plant as his thing. So it might make sense to shift resident inspectors every so often.

STEWART: With regard to training, I'd be curious how other agencies — especially the Federal Aviation Administration — try to ensure high-quality performance and care in a technology/"human error" situation. Do you know what the differences are, between N.R.C. and F.A.A., in how they train their personnel?

YELLIN: No, but I'd like to know. That's an extremely good question. The F.A.A. is only one example. We ought to learn everything we can about the differences among safety practices and regulations for different sorts of high-risk activities in this country and abroad.

MARCUS: What about public perceptions of risk, and people's continually reinforced suspicions that the technical experts — who assure them everything is all right — are not quite telling the truth?

Relative Risk

STEWART: This raises a larger question: How do we as a society assess nuclear risks and compare them to the risks from other energy sources? The Congress has not been a good mechanism for deciding that; and I don't think the Executive Branch has been a very good mechanism either. What are fundamentally *political* choices among alternative energy sources have been treated as technical or regulatory



issues and have not been brought to public discussion and debate. On top of this, many people — the general public and politicians alike — feel or claim that they've been lied to.

PHILLIPS: Harold Green, a former Atomic Energy Commission attorney, stated some years ago (in his testimony before the Pennsylvania Insurance Commission on the Price-Anderson Act in 1973) the following: "For the better part of the past two decades there has been a calculated effort on the part of the atomic energy establishment, industry, the A.E.C. (now the N.R.C.) and the Joint Committee on Atomic Energy to minimize and conceal the risks of nuclear power."

RASMUSSEN: The risks of nuclear power have been discussed a great deal, by both the pros and the cons. Certainly the fact that there are risks associated with it has not been denied by anybody that I know.

YELLIN: Norm, I think in fairness that you have to agree with Harold if you look back over the past 20 years or so. Certainly it would be ridiculous to suggest that the issues of nuclear safety haven't been discussed over the past five years, but there is evidence that in a number of earlier instances there was a very deliberate effort to mislead.

RASMUSSEN: Perhaps in the old A.E.C. days — I'm not arguing with that.

MARCUS: But even recently, the Lewis committee specifically stated in its report [*Risk Assessment Review Group Report to the U.S. Nuclear Regulatory Commission*, September 1978] that they observed a "siege mentality" among many people in the N.R.C.

RASMUSSEN: Well, that's not the same thing. What they're talking about is a defensive reaction when attacked from the outside. Anybody gets like that after you attack him enough.

MARCUS: In the past several years, there seems to have been a deliberate strategy among nuclear advocates — to admit there are risks but to compare these risks to those of other alternatives. And it's implied that when this is done correctly, nuclear power looks relatively good. In *WASH-1400*, Professor Rasmussen, you compare the risks of nuclear

power to other societal risks (hurricanes, for example), but these are mostly non-energy related. I've heard people in the nuclear industry refer to the risks from coal mining and combustion, but I haven't seen a great deal of data on comparison of risks between various energy options.

YELLIN: We can give you a list. My own point of view, however, is that such risk estimates are unreliable because the uncertainties are so big. If you're going to put a number on the mortality risks from nuclear power, then there's a big range of uncertainty; and this overlaps the range of risks, which also are very uncertain, from burning coal.

RASMUSSEN: The extreme upper bound that the Ford/Mitre study [*Nuclear Power Issues and Choices*, Ballinger 1977] used for nuclear overlapped with the lower bound for coal. Typical figures from coal are much higher than for nuclear. Fatalities from a 1000-megawatt coal station range from 20 to 200 a year, and that's a substantial number of people.

YELLIN: I agree that if you look at the literature you'll find that the range of risk usually given for nuclear power (often without fairly including the risks of reactor accidents) overlaps the "bottom" of the risk range for coal. But I'm saying the uncertainties are sufficiently large that at present you cannot tell the difference between those two risks.

RASMUSSEN: Most of the people who study it wouldn't agree with that.

STEWART: But there are other aspects, too. The problem of risk-bearing is a psychological cost that's not usually reflected. People may be much more concerned about a small probability of a large accident than the almost certain eventuality that a few will die because of coal combustion. I'd also like to point out the political significance — or insignificance — of this comparison. We simply have no political mechanism to say how we trade those things off and whether we should go more for this or more for that. These numbers are used by analysts or maybe in a nuclear regulatory proceeding. But they're not added up in any political sense.

MIT '79

The Majestic Setting of Killian Court Makes Graduation a Gala of Fellowship and Triumph

The Killian Court will hold bittersweet memories for every member of the Class of 1979: the place of both beginning and end.

The beginning was on August 29, 1975. "Abandon hope, all ye who enter here," they were told. "We didn't know what we were getting into," recalls Marcia H. Grabow, '79. She could never have then foretold what would happen on June 4, 1979: standing as president of her class in front of more than 7,000 students, parents, and friends at the largest Graduation Exercise in M.I.T.'s history, with the most majestic backdrop that the Institute — perhaps even the entire Greater Boston area — can provide, Ms. Grabow said proudly.

"Now we are M.I.T."

The warmth and cheer of the first outdoor Commencement since 1927 was hardly dampened at all by a brief, light shower. The weather for June 4 had been on everyone's mind for days: would it spoil the second bold excursion in over 50 years into that extraordinarily impressive ceremonial site? (Even while they designed the Killian Court setting, uneasy planners had arrayed the usual chairs in Rockwell Cage. The same precaution had been impossible in 1959, when a June "northeaster" drowned the inauguration ceremonies planned for Julius A. Stratton, '23, as eleventh president; much contorted, they were moved to Kresge Auditorium.) The record for the date in Boston is 90 per cent: rain on only one of ten days in early June.

This year the weather was just what Edward C. Nelson of the Meteorology Department predicted when Professor Gerald L. Wilson, '61, Chairman of the Commencement Committee, made the final decision at 5 a.m.: while Cape Cod might be soaked by a storm slipping off the coast, Boston would escape with at most a light shower. And so it was: enough to wet the pavements (except under the trees), bring forth a flowering of umbrellas so colorful as to eclipse the rhododendrons and azaleas, and give President

Commencement A1

The largest Graduation Exercises in M.I.T. history under cloudy skies and a splash of rain in Killian Court.

(Photos by Gordon R. Haff, '79, William D. Hofmann, '80, and Marjorie Lyon)

Courses A14

People A21

The science advisor to the White House: "Much of the country's future depends on how . . . leaders embrace science and technology."

Under the Domes A27

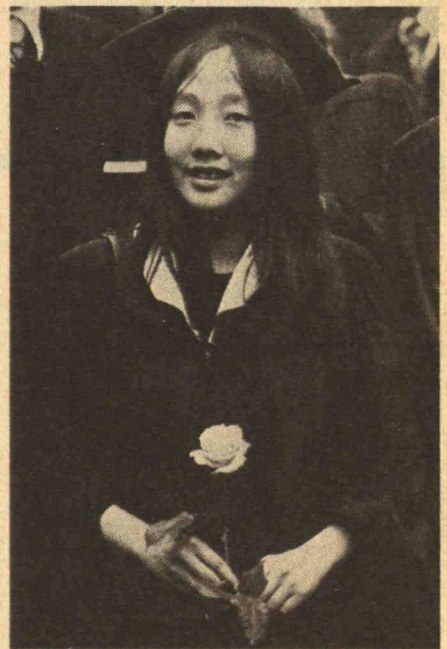
The Leadership Campaign aims to overshoot its \$225 million goal; Dean Horn on the "absurdity of absolutes"; and an account of President Wiesner's day in class.

Students A33

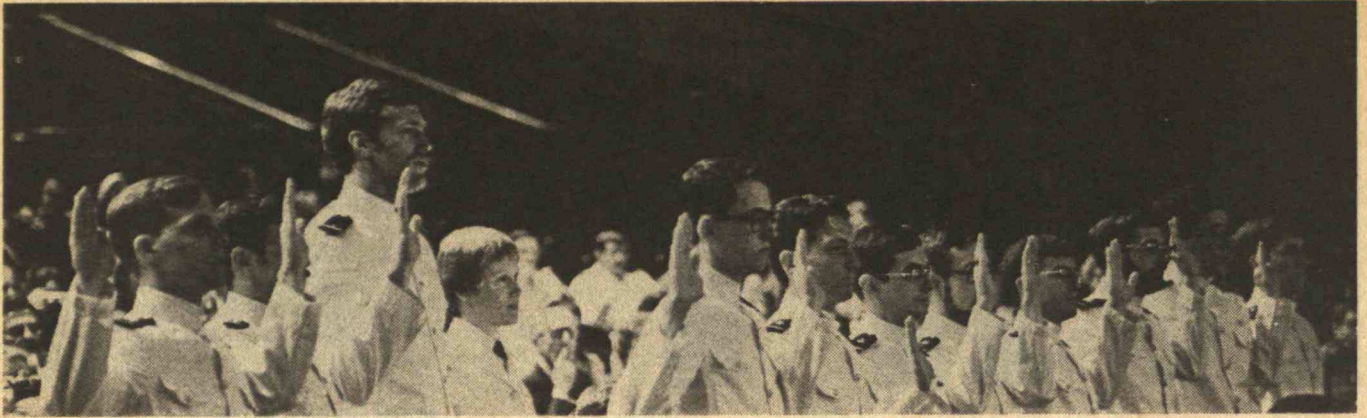
Barry Newman, '79, on being U.A.P.

Puzzle Corner A36

Allan J. Gottlieb, '67



Did you mind the rain in Killian Court? they asked a (slightly) dampened parent. "Not when it's your little girl up there," the beaming father said.



Army Husband Commissions Navy Wife as M.I.T. Graduates 37 New Military Officers

Fourteen Air Force cadets, 11 Army cadets, and 12 Navy midshipmen — one of whom took the oath of office from her Army-officer husband — were commissioned Sunday, June 3, the day before they received their S.B. degrees in M.I.T.'s 1979 Graduation Exercises.

The new officers — lieutenants in the Army and Air Force, ensigns in the Navy — completed R.O.T.C. programs while working on their undergraduate degrees.

M.I.T. is one of the few universities which have reserve officer training programs involving all branches of the armed forces — Army, Navy, Air Force, and Marine Corps. Rear Admiral Carl A. Brettschneider, commandant of the Fourth Naval District (northeastern United States) spoke at the brief commissioning

ceremonies in Kresge Auditorium.

Patricia T. Strat, '79, was commissioned by her husband, Second Lieutenant Thomas M. Strat, '78, who received his S.B. in electrical engineering a year ago. The Strats met in 1975 and were married last year, following Lieutenant Strat's commissioning. He remained at M.I.T. for graduate study and received his S.M. in electrical engineering in January. He is currently stationed at Fort Devens, Mass.

Ensign Strat, whose S.B. is in interdisciplinary studies with a concentration in meteorology, and her husband have received duty assignments within five miles of one another in Monterey, Calif. He will be with the Communications Signal Security Detachment, 7th Infantry, Fort Ord, and she will be with the U.S. Navy's Fleet Numerical Weather Central.

The other officers were commissioned by the heads of their respective R.O.T.C. pro-

grams — Air Force Colonel William R. Trott, Army Colonel John S. Kark and Navy Captain John H. Sweeney III, N.E. '60.



Wiesner an opening for several one-liners. But the skies lightened long before the 1,400 graduates had their degrees, and the post-Commencement receptions lasted well into the early afternoon: everyone seemed to want to prolong the moment of sentiment, fellowship and triumph.

Toward a Responsive, Learning Society

Having recalled an (apocryphal?) story from another dampened commencement — a parent was heard to remark, "After the soaking I've taken for the last four years, what's a little rain?" — President Wiesner delivered a much-abbreviated version of his prepared remarks, urging a national "reconciliation between technology, social evolution, and human aspirations.

"I believe today's problems stem . . . from a lack of appreciation of the inherently experimental trial-and-error nature of social progress, and from changes in the character of our industrial society — its scale and interconnectedness," Dr. Wiesner said.

"We must achieve a deeper understanding of how a democratic, technological society functions. We need to speed up the technical and social developments that are conceptually possible but currently blocked by our confused bureaucratic system." The challenge of the times, Dr. Wiesner said, is "to create a societally responsive, but at the same time self-directing, industrial system, one that is an effective learning system."

That national agenda is "tailor-made" for the Class of 1979. "You have the knowledge of science, the knowledge of technology, the knowledge

of social sciences and the humanities. You, better than most, understand something about dynamic systems and especially the complexity of the learning process. What task is more worthy of your efforts?" he asked the graduates. (The full message from Dr. Wiesner's prepared Commencement address appears on pages A11-A12.)

Representing her classmates, Ms. Grabow also talked about bridging gaps. But hers were smaller ones — between people and groups at M.I.T. Thus she explained the class' decision to designate its gift for a transformation of the intersection of buildings 2 and 6 into a lounge space where students can "relax and talk." The seniors' total of \$1,340 was matched by a similar sum from the 50-year Class of 1929; that total, said Ms. Grabow, was enough to also cover the gift of a tree to be planted south of the Nevelson sculpture, "Transparent Horizons," between the East Campus parallels. Perhaps it would soften the impact — visual or emotional — of that controversial work, she said.

New Logistics in a New Setting

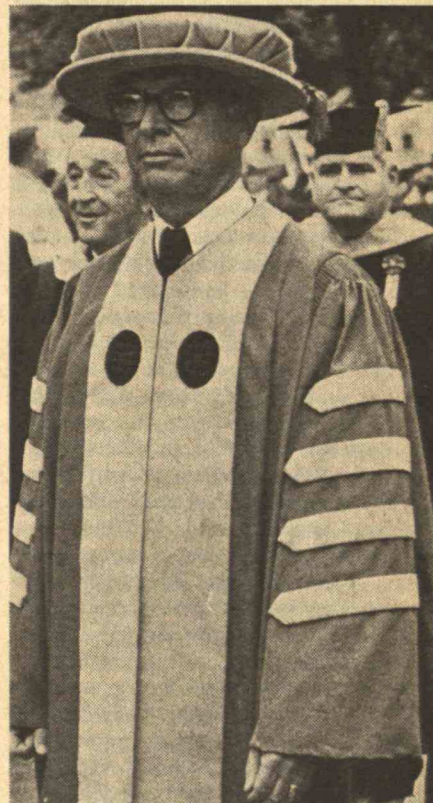
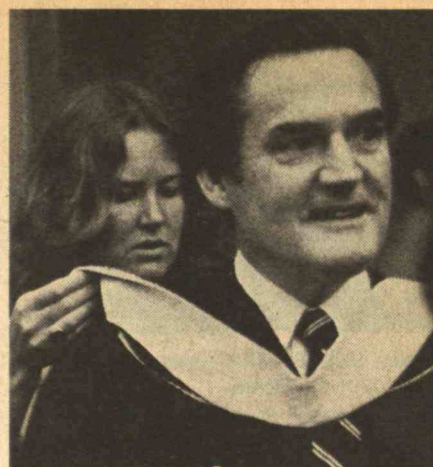
A wholly new setting for Commencement was created in the Killian Court by Professor Wayne V. Andersen of the Department of Architecture — a three-section podium with seating for 106 members of the Corporation, 156 members of the faculty, and some 30 guests of honor. Among the latter were the governor of the Commonwealth, Edward J. King, in his role as *ex officio* member of the Corporation; introduced by President Wiesner, he drew a mixture of applause and hisses — the latter mostly from the Class of 1979 for reasons made clear elsewhere in this issue.

Professor Andersen's plan included an awning to shade the dignitaries from rain and sun. It looked so much like a sail that the task of designing and creating it fell to Professor Jerome H. Milgram, '61, of the Department of Ocean Engineering. For ceremonial music, John S. Oliver, Director of the M.I.T. Choral Society, led a chorale and John D. Corley, Director of the Concert Band, a brass ensemble. Hanley Sound, specialists who earned their laurels bringing rock concerts to large outdoor audiences, arranged for music and voice to reach the far corners of the Killian Court with minimal distortion. For all these arrangements, the budget was only \$40,000 more than for a conventional Commencement in Rockwell Cage, according to Professor Wilson; and since most of the new arrangements are modular, reusable next year, the cost then will be lower.

Management problems overshadowed the budgetary ones, but everything proceeded without a hitch. While students and faculty robed on the West Campus as usual, the Corporation and guests of honor met in the Bush Room. Marches from these three locations melded into a single academic procession in front of 77 Massachusetts Avenue, making its way from there around building 5 and 1 on Massachusetts Avenue and Memorial Drive to enter Killian Court from the south.

Traffic was blocked on Massachusetts Avenue for just over eight minutes beginning at 9:48, but the cacophony of motorists' horns served chiefly to muddle the bullhorns and chanting of a small band of Cambridgeport protesters. They were registering dismay at possible use by Polaroid Corp. of M.I.T.'s land northwest of the M.I.T. reactor. "R & D has got to go," they chanted — a feeble, incongruous voice indeed as perhaps 1,000 new recruits received their entry credentials for U.S. industrial service on the greensward of what was once touted by the city of Cambridge as "research row."

The program for the Graduation Exercises showed some 1,945 degrees to be awarded to 1,650 seniors and graduate students; just under 1,400 of the latter were present at Commencement. Among the degrees were seven given jointly with Woods Hole Oceanographic Institution; 1,026 bachelor's degrees, 557 master's degrees, 216 Ph.D.s, 38 Sc.D.s, 66 master's degrees in architecture and planning, and 35 engineer's degrees in various fields. — J.M.



Among Commencement dignitaries: Edward J. King (above), governor of Massachusetts, marched as *ex-officio* member of the M.I.T. Corporation; while Joe F. Moore, '52, president of the Alumni Association, led the academic procession as chief marshal. (Photos: Gordon R. Haff, '79)

Meet the Class of 1979



Robert Hull: Seeking Things You Can't Pin Down

Robert Hull is a natural actor. He has an edge of shyness that he pops through in his exuberance about an idea or experience. Then he spontaneously pantomimes it, vascillating between a serious and humorous demeanor.

"I've been acting since the third grade (in Broomall, Philadelphia). I was attracted to M.I.T. because I was strong in math — and I kidded myself into thinking I was strong in physics. I wasn't serious about acting then. But I wanted to participate." M.I.T.'s three acting groups and community players were a magnet, and so were M.I.T.'s music groups; Robert plays the trumpet.

In two years his stronger interests emerged and Robert changed his major to literature and writing. Now he is fully committed to acting and writing; he cares little that these are precarious professions.

Having made that decision, why did he stay at M.I.T.? Bob admits that "with respect to acting I felt weird at M.I.T." There is no acting program here. "But I thought I was getting a lot out of the Shakespeare Ensemble. They pay real attention to detail. And Murray Biggs was the best I could find." An important experience was working in a Shakespeare acting group for two summers at Drew University in New Jersey. He was one of two from M.I.T. in the group. The others were from acting schools. "The most important thing I got out of it is a *dedication* to acting." This fall he will be a guest artist in

the Boston Shakespeare Company.

Robert says he's changed his attitude since he arrived at M.I.T. "When I came here, I liked the pat answer. Now I think there are no pat answers; that's a naive way of looking at things. I'm interested in things you can't pin down." — *M.L.*



Charles Eliot: I'd Do It All Again

Charles Eliot is definitely a thinker. He also greatly enjoys life, is friendly, outgoing, modest, charming, knowledgeable, and speaks easily and articulately. And one last observation — he knows who he is and what he wants to pursue.

Charles will go to Oxford next September as a Rhodes Scholar, to study nuclear magnetic resonance. He is half British (his mother), and his father was educated in England. Charles is Canadian, the only Canadian scientist among 32 American and 11 Canadian Rhodes Scholars that will arrive in England next October on board the *Queen Elizabeth II*.

Why had he chosen M.I.T.? I asked. "When I was young, I wanted to be an astronaut. I was interested in physics, chemistry, and math. I decided to come to M.I.T. for these — and to study more music. I'm a classical guitarist. There's a lot going



on in Boston (in music)." (The strength of his interest is measured by the fact that he took a year off from M.I.T. to study classical guitar in Greece, where his parents, both classicists, were teaching.)

Charles says that he is happy — that he enjoys life, and has done so at M.I.T. "I like to know how things work and I like to have friends. . . . I've never met a person at M.I.T. who I didn't find fascinating. Nietzsche once said that the test of our happiness is whether at this moment we would relive our lives *exactly* as it was — with all the pain, and happiness. Yes, I would."

"I feel full. I'm an academic type — I like to read, think, teach (people are always asking me things); and I want to be a teacher. The way my mind works, I think I can make a greater contribution to science and global understanding (although it may be a drop in the ocean) by trying to show what I understand about physics and chemistry. I'm not an original thinker, but I tend to be a strong understander." Charles thinks he can identify, in the history of science, a few people who have been distinguished as teachers by the accomplishments of their students — teachers with five or six Nobel prize winners among their students, and he wants to be such a teacher. "I honestly believe one can teach ways of thinking. In the end, education is about teaching *how* to think, not *what* to think. That's the hardest."

I asked him to look back over the last four years and discovered two more of Charles' passions: "At this point in my life I'd like to stop and reread everything I've ever read

again, to rethink everything, from my present vantage point. Take Shakespeare [he is a member of the Shakespeare Ensemble]. You either admire or hate it in high school, but you never understand it. Now I'm just starting to see what Shakespeare had in mind. I'm looking at *Hamlet* again, after four years. *The Winter's Tale* is my favorite. I love beautiful writing, language, construction, and thought. My favorite sensation when I read something is, 'Oh, that feels good.'

"My single biggest triumph was winning a varsity letter (for which you must place in every meet) on the track team, as a high jumper. I like high jumping because it's a very dramatic event. If you watch high jumpers it's as if there's no way it seems it can be done." — M.L.



James Thompson: 3-D Art

Jim is tall, thin, gentle, soft-spoken, an architecture major. It's hard to imagine that next year he will be doing construction and management work in his home town near Pittsburgh. "The last year has been hectic," he says. "I felt I didn't have time to look at graduate schools, so I'll take a year off."

Jim Thompson always wanted to be in architecture. "I was wood-carving at 12. I enjoy drawing. Architecture was the opportunity to develop three-dimensional art."

But even though his basic interests haven't changed, Jim thinks he's changed a lot — "grown up a good deal" — since he came to Cambridge. "I've made special friends, learned from my peers, become involved in extracurricular activities."

M.I.T. was completely new to him: "I'd never been in Cambridge before the day I came as a student," he remembers. Everyone has an image of M.I.T., but as Jim recalls it the Institute turned out to be very different from what he imagined. "When I got here I was confronted with types of people I never before encountered," he remembers; "I thought it would take me time to get adjusted." But it didn't, he thinks; and part of the reason is that he joined a fraternity. From that experience came his conclusions that living groups are "very important," and so he became active in his fraternity house and, soon enough, in the Interfraternity Conference. A lesson from that experience: "if we have a problem, the chances are someone else has the same problem." — M.L.





**Robert Mandel: The Balloon Girl
Never Called**

Robert Mandel is genuine, candid, light-hearted. He has a keen sense of the absurd, or — to be specific — the humor in life at M.I.T. His criticisms of M.I.T. come across with little rancor: one feels gently chided and much the wiser for it.

Rob "wasn't crazy" about the first year here: he wasn't totally directed as a freshman ("People would say, 'What do you mean you don't know what you want to do?'" he explains.) And "the social life was really poor," he says. So he did something about it. "I moved to Senior House — and in desperation I designed some message balloons from cleaner bags. I soaked cotton in rubbing alcohol, stuffed it into an aluminum cup, attached the cup to the bags with four straws, and launched my message: something about a lonely M.I.T. student. We waited for the balloon girl to call. She didn't."

Then he tried another tack: "I got tired of the dorm system, so I started Alpha Delta Phi, a fraternity on Massachusetts Avenue."

A year later he was ready to try something different again. He spent his junior year at Vassar studying philosophy and religion (at M.I.T. he is a management major). "I wanted to take humanities at a humanities school. Here, if you take more than one semester of humanities, people say, 'What's your problem?'" Vassar turned out to be very different from M.I.T. "People don't necessarily enjoy M.I.T., but they get jobs. At Vassar, people really enjoy themselves — and they don't get jobs right away. The professors are there to teach; here, they're here to do research. Here I have to make an appointment three weeks in advance to see my advisor (and then he'll break it). There, the school is for students; here, the students are not the primary concern."



Rob will go to medical school in the fall, responding to an interest spawned while working during the summer at Mt. Sinai Hospital in New York as a rehabilitation counselor's aid. He tutored welfare people in math and English toward their high school diplomas and also had the opportunity to go on rounds with his boss. He was attracted to management, he says, "because it's more practical, people-oriented, and the real world. It's the same reason I'm going into medicine — to be dealing with people and seeing the results first hand. I would never go into research, where the results are esoteric. The core of both management and medicine is people."

In four years since 1975 when he came to M.I.T., Rob thinks he's changed quite a lot. "I'm more relaxed now," he says. "I can't get upset as much as I used to. I always felt I should be willing to sacrifice that which I am, for that which I could be. So I tried lots of experiments. I liked Senior House but I tried a fraternity; I liked that but chanced Vassar. So I really appreciated the flexibility I found here." — M.L.



Lisa Egbonu: Living with Prejudice

Lisa Egbonu is outgoing, completely natural, unselfconscious, charming, and pretty. She doesn't want to be narrow, does not play it safe, has wide interests, and tries new things. She acknowledges prejudice with anger and frustration but with no thought of it as an obstacle between her and her goals.

Lisa is a participator: a cheerleader as a freshman at M.I.T., a participant in "lots of activities, meetings, women's discussion groups," secretary and then coordinator of the Black Student Union's tutorial program, a member of the Committee on Academic Performance and of Alpha Kappa Alpha, a national organization of black women which is the only sorority on campus. And she makes a difference. She developed a freshman "buddy system" (where freshmen have an upperclassman mentor) and helped to create a problem solving seminar — innovations which led to a job as assistant to the director in the Office of Minority Education.

Lisa started at M.I.T. as a chemistry major and switched to applied biology. Next year she will be a medical student at Johns Hopkins. Her interests are wide, centering especially on public health policy: Who decides what health facilities will be built or closed; who is going to pay? She would like to work in Nigeria, where her father spent part of his life.

"Is it going to be a problem, being a woman in medicine?" I asked. "It is in that



people question your lifestyle, how you'll fit the family in with your career. I feel social pressure — that 'of course' you have to choose; that you should stop your career if you want children." But Lisa insists that she has the option of having both family and career. "Women, especially black women, cannot depend on society to define their identities or horizons. We have to define ourselves."

She trusts her own decisions and makes them confidently in the face of pressure. "I decided not to go to Harvard Medical School, although there was lots of pressure to do so. Hopkins has a lot of black patients, Harvard doesn't. . . . Whether people like it or not, it's the poor patients you work with, and Hopkins' poor patients are black. . . . So I'll be serving more as a role model. That's worth something. . . . If you look at the ratio of black doctors to black people, it has essentially stayed the same. It's (that kind of thing) you can try to help. Hopefully, sometimes, as a black doctor I'll be wanted instead of tolerated."

"It would be safer going to Harvard — less risk of running into problems, and if I do there are more people I know for support."

"You don't choose the safe route?" I asked.

"Nah. I need a change of place. I've been here four years, and I want to see somewhere different. . . . It was a good decision to come here; but . . . it's not like you can hold onto it."

What about living in Boston? Lisa won't remember living here as an entirely pleas-

ant experience. "Boston is a racist city," she says. "I feel like they don't want black people here. The media present stereotypes of blacks — not real people."

"I feel that there is only a narrow area of Boston I can walk in and not have people bother me. I would never walk across the Harvard bridge at night, for instance — people would threaten to throw me off. I could tolerate it more if it were isolated to one area, but it's not like that. . . ."

Is M.I.T. better? Yes, and no. "Here there is a backlash — part of a national backlash," she thinks. "I don't think people here are less prejudiced than the rest of society. Whites think black students are getting more advantages. But that's a joke: no white person would switch positions with a black person in this society." Lisa finds professors — and everybody, really — very accessible here. But she says "On a gut level I don't really believe things have changed much. This is M.I.T. and it seems like it will always be the same. It's an institution by and for white males; people who don't fit that mold are still on the fringes." — *M.L.*



Andy Adler: You Need to be Aggressive . . .

Andy Adler came to M.I.T. with "a strong conviction that it wasn't just science I was interested in. But I wouldn't have predicted that I'd go toward philosophy and psychology," he told me, and he surely wouldn't have guessed that he'd be running an all-night peer-counseling program. ("Before I came I thought it was ridiculous to go to a psychiatrist," says Andy.)

If you'd asked Andy in September, 1975, he'd have said he expected to study math and computers. All that began to change as soon as he became part of the Experimental Study Group, which has been his "home" ever since early in his freshman year. Now he plans to do research in cognitive psychology or artificial intelligence. He'd like to create "a community of scholars doing studies with friends. It's something I had a glimpse of in E.S.G.," he says — "to spend time the way you choose, to explore topics, do research, learn, do things that make sense at the moment and see where they go."

"M.I.T. doesn't run things rigidly by the guide book," says Andy. "Everyone is open-minded. You just need to be a little aggressive — and the mystique around the professors disappears. If you go up and talk to them it's amazing how friendly and helpful they are. They listen to my ideas now, and encourage me."

It was that kind of human concern that Andy wanted to reflect when he established M.I.T.'s "night-line" last fall. Students stand by to receive calls from fellow-students between 7 p.m. and 7 a.m. every day. The idea is "to give people a chance to talk to someone," Andy explains. Part of it is giving information (Where is a drug store open at 3 a.m.? What's the movie? What time is it?). But that wasn't Andy's point: "The meaning-





Michael Gold: "Dancing, Video, Performance ..."

His sense of humor kept bubbling up from right below the mock-serious facade. He played parts — first the hesitant, reluctant interviewee, then the loquacious charmer. He chose words with colorful juxtapositions, was constantly curious about my notes, and was definitely a participator (in mid-sentence as we sat in Killian court, he jumped to catch an errant frisbee).

"I changed a lot during my first couple of years here," Michael Gold thinks. "In high school I was interested in intellectual things, always playing chess or writing computer programs. But something about M.I.T. repelled me from technology. After two years here taking physics and math, I found myself rejecting this intense intellectual atmosphere. I flirted with architecture, and then I majored in music, and I'll get my degree in humanities."

But Michael's love affair with technology hasn't wholly ended. What he really wants to do is use electronics and computers in composing and making music. So he's studied a lot of electrical engineering and computer science in addition to music theory and composition, and for a while he thought about taking two degrees — in computer science and in humanities. "But there was too much pressure in the E.E. courses," he says. "The message I've gotten from that department is, 'Too many people want to major in E.E., so we're going to make life as painful for you as possible.'

It's an army boot camp mentality."

Michael's fascination with the possibilities of technology in music is compelling. He's especially interested in "how people interact with programs. We want to break down the barriers between people and computers," he says.

With Professor Richard Hoffman of Oberlin, Michael worked in the computer music laboratory on a string quartet with accompaniment by a computer. "It's possible to invent an infinite number of ways of producing tones. I was responsible for how the computer was realizing the sounds of notes as well as the notes themselves," Michael explains. He's also finishing a big, complicated piece which was described to the computer in terms of musical notations instead of the usual computer alphabets of letters and numbers. ("It took us four months that way, and we probably couldn't have done it any other way at all.")

"One point of view is that music is first a set of tonal rules; and *then* music. But I don't think so. I have mystical leanings. What is a good melody? Someone can tell you why melody *isn't* good; but it's very hard to say why it *is* good."

What next? Michael would like to go to Holland: "I've always been attracted to the Netherlands and to travel." Another possibility: a job with a synthesizer manufacturer; this would be applying computer technology in synthesizers, (a musical instrument that produces or alters sounds through electronic means).

"I'm interested in the fringes between commercial and serious music. My dream is to open a recording studio to do film scoring and electronic music. I can see myself being involved some day with a group of artists concerned with dancing, video, film, performance, and recording. It all would take place on one site." — M.L.

ful thing is the opportunity for students to talk to someone about anything in the middle of the night. That's the time when it's too late for anyone to be up unless they're working, and then you don't want to bother them."

Andy adds up his four years this way: "I'm seeing that there's more and more in the world — it's not as limited as you think. The really invaluable things you learn aren't the things you came here to learn. They are about life, what you want, how you're going to get it, how to live with yourself." — M.L.





Barry Newman: Happy Participator

Barry exudes energy. He will study corporate law part time in New York in the evening next year, and in September, 1981, he will go to Harvard Business School. That's after only three years at M.I.T., which he leaves with degrees in chemical engineering and biology. He says he doesn't want to leave, but it's time. "I wasn't happy with academia the first three semesters, but I got elected chairman of the Student Center Committee. So I stayed (instead of transferring).

And he now concludes that, "I got what I wanted. I made a niche for myself here and I'm happy with what I did. I got a real education, I got involved in student government, and I've developed a better perspective now on what I want to do."

Barry says "the exposure here has been phenomenal. My interests have expanded, while most people narrow down what they want to do. Now there are a lot more things I want to do than I have time for, and all I can say is that I'll try to enjoy as much as I can get my hands on. If I do as many things as I can as well as I can, things will work out. They have thus far."

Barry is a participator. "I like a frenzied pace — it's exciting. The more I do, the better picture I get. That's how I approached activities, that's how I approached school, and hopefully that's how I'll approach work."

"That's why I'm headed for management. I came here because of an interest in science. That's been part of my growth, too. Now I know I don't have a professional interest in science, but I do in economics. Business school is not a far throw from economics. — M.L.



Rebecca Waring: Budding Businesswoman

Rebecca Waring came to M.I.T. from Spence, an all-girls private high school in New York with only 30 in the senior class. Though the atmosphere there was very competitive ("more competitive than here," she thinks), M.I.T. was a big change. For one thing, the emphasis at Spence was on English, history, and languages. For another, Rebecca remembers that she had "no contact with men before." But at M.I.T. she moved right into a co-ed suite in a co-ed dorm first semester. Given all this, Rebecca thinks she "got used to M.I.T. very quickly."

But now she's reached "the point where all the work and pressure have started to get to me. I could take it for four years, but that's enough."

Rebecca's degree is in civil engineering; her field is environmental engineering — investigating sources of air and water pollu-

tion. But Rebecca seems to think her future career may have been molded as much or more by her experiences at *The Tech*, where she worked for four years in many capacities — managing editor, production manager, senior editor, and contributing editor. There, she says, she learned that she'd make a good manager. She learned "a certain psychology to get things done," and "I also became a lot more self-confident." So she's been accepted at Harvard Business School on a deferred admission.

"The typical stereotype of an M.I.T. is a gnuerd," says Rebecca, "but I haven't met anyone who spends all the time studying." She doesn't think of herself that way: "I've gained experience in dealing with other people in my living group. And I definitely got experience in management. Before I came here I thought I could do anything. Now I know that, yes — I will, I can be a businesswoman. — M.L.



"... a Good Place to Spend Three Crucial Years of My Life ..."

His last term as an M.I.T. undergraduate "thundering" to a close, Joel West, '79, waxed nostalgic for The Tech: Why had he come to M.I.T. in the first place, what he had expected, and what had really happened to him as a student here? Technology Review thought his answers interesting and provocative, and we reprint them here with permission of the author and The Tech:

It's strange. It was never questioned whether I'd go to college; with a mother with a master's degree and a dad with a law degree, it had always been assumed by all concerned that this bright (though obnoxious) kid would get a bachelor's degree.

So it was that, having never been more than five miles outside of the territorial boundaries of the great state of California, one would-be electrical engineer hugged mommy and daddy and little sister goodbye 45 months ago and hopped on the red-eye to Boston's Logan Airport. Needless to say, I promptly went into a state of cultural shock, having absolutely no conception of what an eastern city was like. (San Francisco, the closest thing back home, I'd only visited once.)

The remainder of the year was a futile attempt to adjust — to living away from home, to Boston, to M.I.T., to no longer being the biggest math whiz within a radius of ten miles — all problems which many freshmen have to face. Also, thanks to the benefits of

freshman pass/fail, I refined timewasting to an art, between dungeons and dragons and fan-tan and generally being annoying — enough so to be the Baker M.O.F. (Most Obnoxious Freshman).

Where I consider myself to be different — and fortunate — is that I left M.I.T. three years ago, possibly to never return.

I first set off to be a computer programmer, a fine and noble profession practiced by many M.I.T. students seeking to pay the absurd tuition charged by the folks at 77 Massachusetts Ave. As with most freshmen, the first summer back wasn't too bad — all your friends from high school are there, it's probably not too different from the previous summer.

What was terrifying was when all my friends started going back to school, none of them locally, leaving me stranded all alone in San Diego, Calif. (something I would not wish on anyone over 18 and under 65). It wasn't long before I realized that although school was bad, semi-skilled white-collar labor was worse.

Once I came back, I found the best reason for being here. Not the professors, not the labs, not the courses, not even the beautiful sculpture. It's the students. Whether we are aware of it or not, M.I.T. is a relatively small community — in August 1977, after being gone a year, I still exchanged looks of recognition with a dozen people each day I walked across campus.

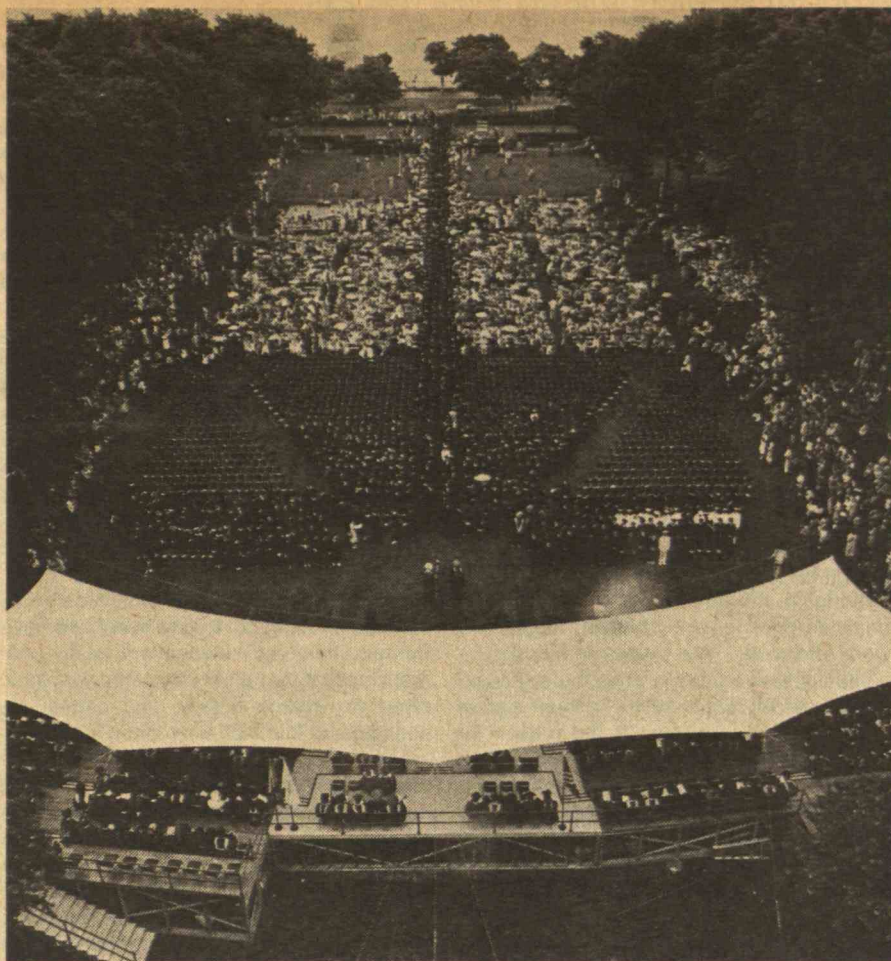
And while I occasionally avow anti-nurdy tendencies, I feel at home surrounded by bright people who regularly debate answers

to problem sets or apply physics to problems from everyday life.

Even at largely residential colleges, most of my friends have not experienced that sense of community which has marked my stay at M.I.T. Ironically, only those at Oxford and that little school up the river seem to have a comparable experience.

Like many seniors, I'll miss M.I.T., but not for the usual reasons. M.I.T. did not prepare me for a high-paying job in industry — I gave up that idea long ago. But it did give me a good place to spend three crucial years of my life, and a place that will be largely responsible for what I'll be 15 years from now.





Commencement Recovers the Great Court, Having Yielded to a Bulldozer in 1928

by Michael Tobias, '78

Not since 1927 has M.I.T. held graduation outdoors in the Great Court, now known as Killian Court. When the time came in 1928, the court had to be abandoned to contractors' equipment engaged in digging up the gravel-covered ground in order to landscape it as it is today. So M.I.T. rented Symphony Hall in Boston for graduation.

Not until 50 years later did commencement exercises return to the great outdoors. Seeing as it took the Children of Israel but 40 years to cross the desert, it's a bit odd that it took M.I.T. 50 years but to go across the Charles and to return to this most splendid and commodious setting. The official explanation in 1929 was that it was necessary not to trample the grass of the newly seeded lawn. (A 50-year wait makes it the slowest growing grass in the world, but of course, traffic between Boston and Cambridge has always been slow.) Since then the explanations have had to do with the likelihood of rain, the discomforts of hot sun, and the costs — financial and psychological — of last-minute changes occasioned by either of those phenomena.

M.I.T. spent the first 20 years of this period graduating in Symphony Hall. During the war, events were held in the auditorium

at New England Life Insurance Co. Though perfectly comfortable, both were but rented auditoriums with no sentimental value to M.I.T. Rockwell Cage, a kind of glorified airplane hangar, evokes more memories of Kitty Hawk than of Mens et Manus. Now at last the culminating event of the year and of the graduates' careers returns to a site which is properly large and singularly M.I.T.

The 1979 ceremony was changed from its recent predecessors only in location. Up until 1950, a presidential handshake was provided, along with hood and diploma, for recipients of advanced degrees; but in order to save time, to equalize the treatment of graduates and undergraduates, and undoubtedly to save the president's hand from increasing class sizes, this practice was eliminated. (In 1969, a metallurgy major managed to kiss President Howard Johnson when handed her diploma, but this idea didn't last either.)

Other things never change. No one has yet received an honorary degree from M.I.T., each student graduates with equal honors, and the president still hands every individual his own diploma — and always the correct one.

In a half century, M.I.T. has come a full circle. The Great Court is well seeded by now, so unless there comes a decision to pave it (or perhaps a torrential rain from an unexpected cloud on some date in the very near future), the Institute should have a home for commencement for many years.



Reconciling Technology and Human Aspirations

Following are excerpts from the address prepared by President Jerome B. Wiesner for the Class of 1979 at the Graduation Exercises in Killian Court on June 4:

In recent years, I have conducted a mini-poll in the weeks before commencement among my friends who are graduating to find out what concerns them as they take their leave of M.I.T. — what's worrying them, what they would like to talk about. Two issues came up repeatedly:

□ First was a concern about the role of science and technology in the future of our society, and especially what an individual M.I.T. graduate could do to influence it.

□ The second concern, a rather plaintive one, that I hear from so many today is "Whom can we trust?" The implied answer is "nobody."

Polls indicate that the people at all levels of our country share a longing to regain a lost sense of confidence and trust in our institutions and in our leadership. I think the concerns expressed in my student mini-poll are interrelated issues — the lack of trust stems primarily from an inability to cope with society's problems, of which technology is one part.

Fortunately, our problems are not ordained by nature — by the shortage of natural resources. They are man-made problems — problems that have arisen in

the course of a continuing effort to make a better and healthier society. Our problems flow not from neglect, incompetence or evil but from ignorance about how a modern society works, of what goals are realistic and of what is required to meet them. This applies particularly to complex issues in the public sector where objectives merge and vie for attention.

The solutions, I believe, lie in the continued use of our intellect and — most especially — through a more effective coupling of the humanistic spirit and the technological drives that are the motivating forces of our society.

Of all our current difficulties, only two could be genuine roadblocks:

- A real shortage of natural energy resources; and
- A mutual distrust of ourselves and our institutions, causing an inability to keep our complex society moving.

Girding for an Energy Transition

As to the first, the United States — and the rest of the world, for that matter — fortunately has adequate basic energy resources to supply indefinitely any reasonable demands that I can foresee. Our reserves in petroleum, coal, oil shale, uranium, solar energy, and tritium are adequate and can be made even more so by effective conservation. Exploiting these resources will not be easy as we make the transition from cheap energy to harder-to-get, expensive energy. That transition will carry with it major challenges for all of us: the need for new technologies, the need to build new industrial systems, the need to understand and control the risks these systems pose, and the need for confidence that what is done is compatible with the environment.

We would have reason for despair if our natural inheritance did not provide us with an adequate energy base upon which to build. But it does. So the problem is straight-forward — we just have to admit to the necessity of the transition, organize ourselves for the task, and be on with it. For one example, I have been convinced that within a decade we could substitute synthetic fuels from coal and oil shale for much of the petroleum we now import. Synthetic fuel costs should not be significantly higher than today's imported oil and would probably be less expensive than imported fuels a decade from now.

Four Imperatives Toward a New Spirit

As to the more general question of trust: I believe today's problems stem not from willful misdeeds by individuals and groups but rather from a lack of appreciation of the inherently experimental trial-and-error nature of social progress and from changes in the scale and interconnectedness of our industrial society. Only through a deeper understanding of how an industrial society works, shared by the whole country, can we over-

come our current defeatist, suspicious mood.

We — you, all of us — must simultaneously work on four fronts if we are to regain a creative, constructive self-respecting spirit:

- We must achieve a deeper understanding of how a democratic technological society functions.
- We need to see to it that these factors are widely understood, both by the information media and the concerned public.
- We need to speed up the technical and social developments that are conceptually possible but currently blocked by our confused bureaucratic system.
- We must assure continued progress toward equity.

Let me cite one particular example of the issues that arise as we try to relate existing institutions to new needs: It is the question of whether we can make a hybrid system involving a mixture of the free market decision-making and detailed regulation work effectively. The market forces are inhibited by the regulatory ones, but the regulators have no responsibility to meet market demands. (This dilemma is the reason for my belief that the President's move to deregulate petroleum prices is vital to meeting the nation's energy needs.) Yet we surely know that we do not want a completely managed system or one with no regulation. Here then is the challenge of the times: to create an industrial system that is societally responsive and at the same time self-directing, and one that is an effective learning system. This is no simple challenge.

Let me stress this point. Our current problems are the inevitable consequences of our collective efforts to keep the social system functioning and evolving. They do not arise simply because of some devious plot of one group to gain unfair advantage over others. For example, large segments of society mistrust industrial corporations because they maximize profits. Yet it is precisely this social force that has driven our industrial machine to be so productive in the first place. On the other side, because the competitive nature of the system makes it unresponsive to what the economists call the externalities, some societal direction is needed. Caught in the middle, corporate executives resent justified criticism of themselves or their products, and they thus add to the current atmosphere of mistrust. In like manner, there has grown a deep suspicion of new technology.

Unless moderated, these confrontations — these widespread distrusts — will surely make it impossible for us to overcome our present problems.

Closing the Gap Between Dream and Reality

There is another source of misunderstanding. Modern technology-based societies like ours have two simultaneous goals — first, and perhaps foremost at this moment of

energy shortages and inflation, is the necessary holding action to retain the achievements of the past — just to maintain our present standard of living. At the same time, we put much effort into improving conditions, trying to make everyone's life a little better. For the past half century we have been concentrating on the latter goal, to achieve more equity in material well-being, in justice, and in access to education and the benefits of the society itself. Added to this drive has been the more recent, unprecedented attempt to protect the environment. These efforts to improve the quality of life have distracted us from the first task, that of just holding our own, which is itself no simple task. Nor is it a task we can afford to shirk. After all, much of life is in truth a struggle against degenerative forces.

We have pursued independently the two goals of holding our own and improving our lot. Perhaps we have actually overextended our material and intellectual resources in doing so. In any event, we have treated them as independent tasks, not realizing that they often competed with each other for scarce human and capital resources and that they were often in conflict.

The need now is for reconciliation between technology, social evolution, and human aspirations — between freedom to innovate and governmental direction. Without this society each year becomes less able to understand its problems. Each year the gap between the reality and the dream grows larger, and each year the consequent polarization between groups grows more severe.

Closing the gap is an agenda tailor-made for you graduates here today. You have the knowledge of science, the knowledge of technology, the knowledge of social sciences and the humanities. You, better than most, understand something about dynamic systems and especially the complexity of the learning process. What task is more worthy of your efforts?

Here at M.I.T. the fledgling Program in Science, Technology and Society is our hope to provide an Institute-wide center for studying these complex problems. I dream of the day when all of us will once again understand the wellsprings of our strengths and potentials and share common goals . . . once again trust each other and our institutions . . . and regard our country with respect and hope.

You asked the question, "Whom can we trust?" I would answer; ourselves — the power of human intellect, our respect for great human achievement, and our inherited ideals of freedom, of individual responsibility, tolerance and decency.

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Master's Program in Transportation

Registration in a new program leading to an S.M. degree in transportation will be open next fall under the auspices of the interdepartmental Center for Transportation Studies. Professor Nigel H. M. Wilson, Ph.D. '70, of the Department of Civil Engineering heads the standing faculty committee in charge.

The idea is to give students "the basic methodological framework to understand transportation problems." There will be a set of core subjects, including transportation systems analysis, and each student will also take a set of three complementary subjects in one specific transport area. The approach will be "quantitative and analytical, reflecting the basic orientation of M.I.T.," says Professor Daniel Roos, '61, director of the Center. Professor Roos thinks it represents "a unique master's program combining technology, systems analysis, planning, policy analysis, and management — all important components of transportation."

Civil Engineering

John S. Marsh, S.M. '66, reports that he is president of the English Paving Co. in Versailles, Ky. . . . **Brice R. Smith, Jr.**, S.M. '52, was one of four recipients of the Missouri Honor Award for Distinguished Service to Engineering from the University of Missouri-Columbia. Mr. Smith's entire professional career has been devoted to the Sverdrup Corp. of St. Louis. In 1952, he started as a designer; then served in Washington, D.C. as engineer in charge of bridges and in later years as financial officer administering international projects and marketing planning. He is also chief executive officer of the Convention Plaza Project, a planned new facility combining public and private buildings located on the north side of downtown St. Louis. . . . **James Weisel**, S.M. '51, writes, "I have been with Merrill Lynch, Pierce, Fenner and Smith for 18 years and am now senior account executive in the Paramus, N.J., office. I still live in nearby Oradell. My son Gary went to work for National Semiconductor in Danbury, Conn., after graduating from Lafayette last year; son Tom is at Princeton; daughter Karen is a junior in high school and very active in swimming. My wife Jean works part-time with discharge planning in the Pascack Valley Hospital."

René W. Luft, Sc.D. '71, has been selected "Young Engineer of the Year" for his valuable contributions to many projects, including the Alaska pipeline and a phased-array radar facility. An associate of the firm Simpson, Gumpertz and Heger, he is also a member of the Seismic Advisory Committee in Massachusetts. . . . **Stanley Prill**, S.M. '56, has been elected president and chief operating officer of Blake Construction Co. . . . **Stanley M. White**, C.E. '76, is a coastal engineering consultant with Dravo Van Houten in New York City. . . . **William J. Murdoch, Jr.**, S.M. '61, has been elected a vice president of Towers, Peerin, Forster and Crosby, management consultants, where he specializes in employee benefits.

II

Mechanical Engineering

John D. MacDougall, Jr., S.M. '70, is currently assigned as resident test engineer at General Electric's Knolls Atomic Power Lab in Groton, Conn. . . . **F. J. Zimmermann**, Sc.D. '50, was appointed head of the Department of Mechanical Engineering of Lafayette College in September of last year. . . . **Warren Poslusny**, S.M. '69, has been named director of marketing and corporate development at Pacific Marine and Supply Co. in Honolulu. . . . **John F. Howard**, S.M. '68, was recently appointed master mechanic at the Chevrolet-Warren plant of General Motors.

III

Materials Science

Jack H. Westbrook, Sc.D. '49, manager of Materials Information Services at the General Electric Research and Development Center, recently delivered the 28th Jeffries Night lecture on "Intermetallic Compounds" at the Cleveland Chapter of the American Society for Metals. . . . **Douglas Fuerstenau**, Sc.D. '53, professor of materials science and mineral engineering at the University of California at Berkeley, was awarded the Guy E. March Silver Medal at South Dakota School of Mines and Technology at the commencement exercises in May. Shortly after that he resumed his international travels — having recently returned from Korea and India. This time, he attended the International Mineral Processing Congress in Poland as the American member of the scientific committee.

Two faculty members in the department have been honored by the American Ceramic Society: **Robert L. Coble**, Sc.D. '55, was invited to deliver the Sosman Memorial Lecture, the society's highest recognition for basic research in the properties of ceramics; **H. Kent Bowen**, Ph.D. '71, received the Schwartzwalder Professional Achievement in Ceramic Engineering Award.

IV

Architecture

Robert P. Burns, M.Arch. '62, was invested as Fellow of the American Institute of Architects in the beginning of June. He is professor of architecture at the North Carolina State University School of Design and was instrumental in instituting the school's graduate program in architecture. In addition to serving as national president of the Association of Collegiate Schools of Architecture, he also maintains a part-time private practice. . . . **Rex M. Ball**, M.Arch. '58, will spend the next year-and-a-half studying ways to maintain and encourage the economic viability of small businesses in his role as chairman of a task force appointed by the White House. By the end of next year 25,000 persons in all 50 states will have been consulted. Mr. Ball is president of H.T.B., an international architectural-engineering-planning firm with headquarters in Oklahoma. . . . **Peter van Dijk**, M.Arch. '56, was also elected a Fellow of the American Institute of Architects this year. After receiving his master's degree, he worked with Eero Saarinen for four years. In 1961 he moved to Cleveland as chief designer of the federal office building there, and when that project was completed he joined what is now the firm of Dalton, van Dijk, Johnson and Partners. His present commitment is the redevelopment of Playhouse Square in Cleveland.

Andrew Lemer: Demonstrating Urban Technology on a Record-Breaking Scale

To Washington, Canberra, and Brasilia, add an unnamed new city in the tropical "middle belt" between the dry sands of the Sahel and the steamy heat of Lagos in the African republic of Nigeria.

The four cities have one thing in common: they are national capitals based on "grand plans placed on virgin land."

But Nigeria's new capital is the most ambitious of all: it is "the largest free-standing new town planning project ever undertaken," says **Andrew C. Lemer**, '67, who has a leading role in the consortium of planners; it's being undertaken by a country whose rate of urban population growth may be as staggering as 75 per cent in the current decade; and it's to be built in almost no time at all: 1.6 million people are to be living in this city where virtually no one now lives by the year 2000, and the nation's government — along with 150,000 residents — is to be installed in permanent facilities there by 1986.

Clearly macro-engineering on a grand scale, which accounts for Dr. Lemer's report on the project to the 1979 annual meeting of the American Association for the Advancement of Science early this year — a session on macro-engineering arranged by Frank P. Davidson of M.I.T.

Nigeria's economy is built on oil, and Dr. Lemer has no doubt that the nation can pay the price of building this wholly new city on 62,500 acres of land.

There will be impressive logistical problems. Most construction materials will have to be imported, and despite the consortium's emphasis on "appropriate technology" dedicated port facilities will be required for Niger River barges on which most materials will be delivered.

But human problems will be the hardest of all. At its peak, the labor force may reach 45,000 — far more than can be accommodated in the surrounding agricultural villages. Population pressure will be enormous; "migration to the job opportunities of the capital will have to be restricted to assure that population does not expand beyond the capacity of the infrastructure," says Dr. Lemer. Lagos, Nigeria's present capital city, is beset with "sprawling slums" and "erratic" water and electric service; it "has long since outgrown the capacity of its infrastructure," he says, and he recalls a recent visitor's comment that Lagos is "well on the way to becoming the Calcutta of Africa."

Should a nation so beset with population and urban problems invest so much in a wholly new city instead of making a more direct attack on the problems of its existing ones? Dr. Lemer thinks so:

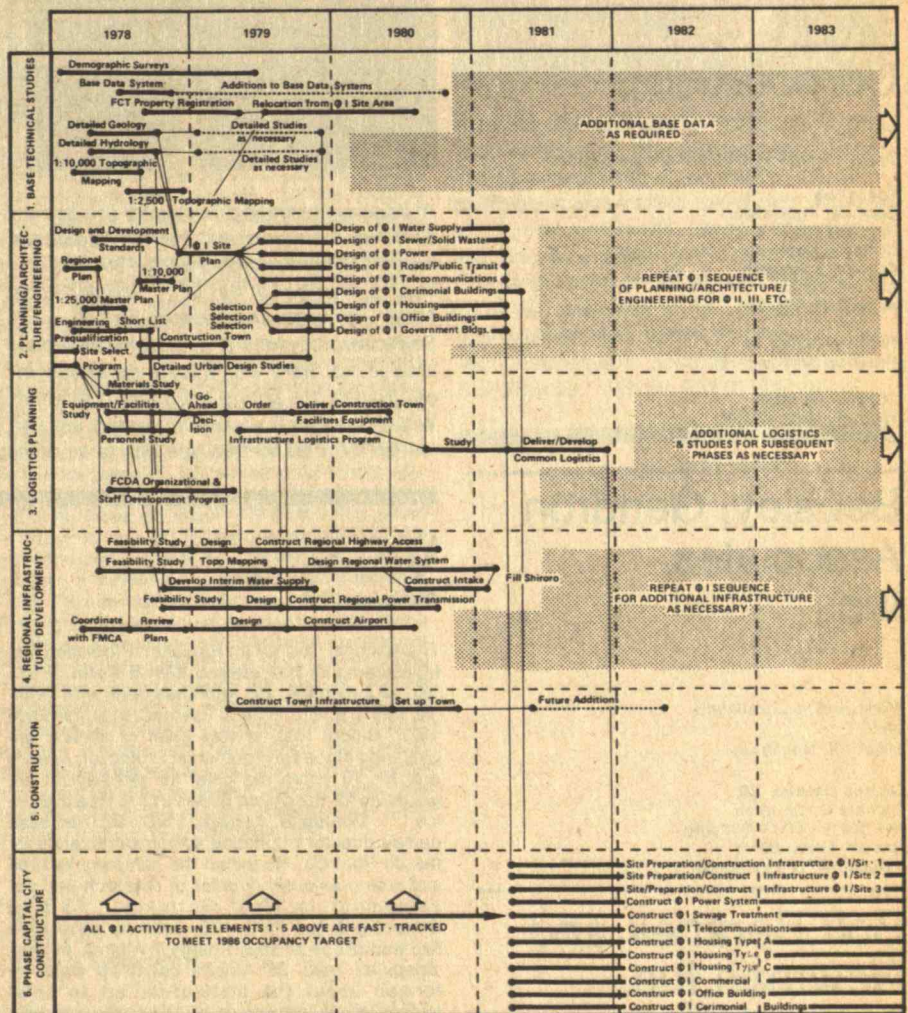
□ Lagos is "clearly an ineffective mechanism for productive integration of migrants into the urban economy," he says.

The new city will be better, and national leaders want it as a magnet to draw urbanization toward areas of the country where development has lagged.

□ The new capital's location has been deliberately chosen for its central location in an "ethnically neutral area"; it will relieve the government of political tensions and gross inefficiencies which now beset it in Lagos.

□ Nigeria's leaders want "a showcase for national unity and modern African urban development."

This is the ambitious program of feasibility studies, design, and construction which must be followed if Nigeria's as-yet-unnamed new capital city is to receive that nation's national government by 1986. It's "the largest free-standing new town planning project ever undertaken," says Andrew C. Lemer, '67, who has a leading role in International Planning Associates, the American consortium formed to help Nigeria plan this major macro-engineering effort.



The consortium — it's known as International Planning Associates (a joint venture of Archisystems, Planning Research Corp., and Wallace, McHarg, Roberts, and Todd, Inc.) has a goal of its own, too. If the new capital city for Nigeria "can demonstrate the value and applicability of new (urban) technologies," Dr. Lemer told the A.A.A.S., "it will have served a valuable function that is unlikely to be possible with existing cities."

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At its annual meeting last winter the Society of Naval Architects and Marine Engineers made C. Richard Soderberg, '20 — he's been a member of the M.I.T. faculty since 1938 — an honorary member. But Dr. Soderberg couldn't attend to receive his plaque, so there was a local ceremony of old friends this spring to convey the honor. With Professor Soderberg (center) are (left to right): Professor Ira Dyer, '49, head of the

Department of Ocean Engineering; J. Harvey Evans, professor emeritus in the department; Keatinge Keays, N.E. '55, administrative officer of the department; Julius A. Stratton, '23, who was president of the Institute when Professor Soderberg was dean of the School of Engineering; and Paul E. Gray, '54, chancellor. (Photo: Calvin Campbell)

V Chemistry

The National Council on Radiation Protection and Measurements has elected **Bernd Kahn**, Ph.D. '60, as a member. Dr. Kahn has been with Georgia Tech's Environmental Resources Center since 1974. Before that he was chief of nuclear engineering at the Environmental Protection Agency and for 16 years the chief for radiological engineering for the United States Public Health Service. . . . **Donald B. Rogers**, Ph.D. '62, has been named director of printing systems marketing for the du Pont Co. He joined the company in 1965 and was previously director of research and development in West Germany. . . . **Kofi Bimpong-Bota**, Ph.D. '75, recently conducted two workshops on solar energy in Atlanta. In May, delegates from 25 African countries were informed about the state-of-the-art in solar technology. A June meeting under the sponsorship of the United Nations University in Tokyo attracted another 30 persons.

Kenneth D. Jordan, Ph.D. '74, spent 1974 to 1978 at Yale, first as an instructor, later as an assistant professor. He then moved on to Pittsburgh and is now an Alfred P. Sloan fellow and a Henry and Camille Dreyfus teacher scholar at Carnegie-Mellon University. . . . **Roger L. Eiss**, Ph.D. '59, is deputy director in Oregon's Department of Economic Development. . . . **Arthur M. Pokanzer**, Ph.D. '57, writes that he is scientific director of the Beralac — the world's only relativistic heavy ion accelerator — and plans to spend the next year at C.E.R.N. in Geneva.

Anna Fang, Ph.D. '65, received her M.D. from the University of Chicago in 1974. She's now affiliated with the Northwestern University and specializes in internal medicine. . . . **Ralph J. Spohn**, Ph.D. '70, is a senior staff chemist in the New Ventures Technology Division of Exxon in

Allendale, N.J. . . . **George A. Frank**, Ph.D. '65, received his J.D. degree from Temple University in May, 1977. . . . **Melvyn M. Kassenoff**, S.M. '66, reports that he is currently employed by Sandoz as a patent attorney.

VI-A Cooperative Program in Electrical Engineering and Computer Science

This year's entering class of 100 students selected from 141 applicants will be the largest in the 62-year history of the VI-A Program. The highest previous enrollments were 1977 and 1978, each with an entering class of 78 students.

The VI-A companies came up with 124 openings this spring, but it was not possible to match all these slots. Part of the increased openings was due to additions to the program. Two divisions of the General Electric Co. joined the program for the first time this year — their Electronic Park Operation in Syracuse, N.Y., and their Special Purpose Computer Center in Bridgeport, Conn. General Electric, incidentally, was the first company to participate in VI-A with M.I.T., having taken its first students back in 1917.

The Motorola Corp., which joined VI-A last year with its Communications Group in Schaumburg, Ill., will be adding its Semiconductor Group operations in Phoenix, Ariz., this summer, and the Fairchild Camera and Instrument Corp. will return after a three-year absence to place students at its Research and Development Laboratory in Palo Alto, Calif., and its Discrete Products Laboratory in South Portland, Maine.

The E.E.C.S. Visiting Committee met at M.I.T. on April 4 and 5. Four of its 24 members are VI-A graduates: **C. Gordon Bell**, '56 (VI-A at G.E. and A.G.E.), now vice president of engineering at Digital Equipment Corp.; **A. Paul Hotte**, '42 (VI-A

at G.E.), now vice president for investor relations for P. R. Mallory and Co.; **Joseph F. Keithley**, '37 (VI-A at Bell Labs) now chairman of Keithley Instruments; and **Howard L. Richardson**, '31 (VI-A at G.E. Schenectady) a corporation member.

Director Tucker addressed the Visiting Committee giving a progress report and bringing them up to date with the growth of the VI-A Program. The Committee also met with students of the Department — among the undergraduates six were VI-A students; of the graduate students three were VI-As.

We have received an extremely interesting letter from **Harold H. Cake**, '21 (VI-A at G.E. Lynn Works), as a result of this column. Harold mentions that he retired in 1971 from a position as president of a large savings and loan association in Portland, Ore. He currently resides in Togard, Ore., and the VI-A Office has his current address.

On another note, Professor (Emeritus) **Karl L. Wildes**, '22, is busily involved in writing a history of the Department. Professor Wildes, many of you will remember, was Professor William H. Timbie's assistant in the VI-A Office from 1926 through 1942. If anyone has reminiscences to share with us please write to either Professor Karl L. Wildes, or me, care of the VI-A Office, Room 38-473.

VI-A was honored, this spring, by having three of its students win coveted Hartz Foundation Fellowships: **John J. Fratamico**, '79 (VI-A at Bell Labs), **David B. Tuckerman**, '79 (VI-A at I.B.M.'s Watson Labs) and **William E. Weihs**, '79 (VI-A at I.B.M.'s Watson Labs). Each of these also were awarded N.S.F. Fellowships. Two other VI-As were awarded N.S.F. Fellowships: **Charles E. Harm**, '79 (VI-A at G.E. Pittsfield), and **Andrew J. Schuler**, '78 (VI-A at Digital Equipment Corp.). Congratulations to them all! — **John A. Tucker**, Director, VI-A Program, Room 38-473, M.I.T., Cambridge, MA 02139

VII

Biology and Life Sciences

William McCormick, Ph.D. '68, has moved his management consulting firm to Belmont, Mass. He writes that his company specializes in strategic planning for the medical products industry. . . . **Thomas Fraser**, Ph.D. '75, is a member of a research team at Upjohn Co. that has produced ovalbumin, a protein found in egg whites, from splicing chicken genes into *E. coli* bacteria. The research report says that the experiment could pave the way for the use of bacteria as tiny factories to produce antibiotics, vaccines, enzymes and other scarce protein substances. . . . We have received a newsletter from Nutrition Action, a public interest group based in Washington, D.C. The executive director is **Michael F. Jacobson**, Ph.D. '69, who explains that the center is concerned not only with our eating habits, but also the politics of food at its source — the family farmer whose livelihood is now threatened by large corporations. In fact, the center is "nipping at the heels of big business like an angry terrier."

VIII

Physics

Stephen J. Lukasik, Ph.D. '53, formerly of Rand, became chief scientist of the Federal Communications Commission in May. His office is responsible for all activities in science and technology, including the management of broadcast frequencies. . . . **J. K. Galt**, Ph.D. '47, has been promoted to vice president of Sandia Laboratories. . . . **Philip C. Myers**, Ph.D. '72, reports that he is assistant professor in the department here, studying the astrophysics of dense interstellar clouds with radioastronomical observations of atomic and molecular spectral lines.

X

Chemical Engineering

P. L. Thibaut Brian, Sc.D. '56, vice president of engineering for Air Products and Chemicals, has been elected a charter member of the Louisiana State University Engineering Hall of Distinction. . . . **Joseph L. Russell**, Sc.D. '55, is senior vice president at Halcon International. . . . The American Institute of Chemical Engineers announces that during a transition period they'll use two sets of figures for units of measure in all their publications. The primary indication will be given in the S.I. (metric) system with the English system following in parenthesis. Chairman of the Metrication Committee is **Evan Buck**, S.M. '61. . . . A note from **Richard L. Bolin**, S.M. '50, reads, "In the past year my wife Jeanne and I have resided briefly in Damascus, San Salvador, and Barbados on assignments for U.N.I.D.O. and I.A.O.B. to create export processing zones."

XI

Urban Studies and Planning

Tomasz Sudra, Ph.D. '72, informs us of his international career: 1975 to 1977 were spent in Brazil planning low income housing; 1977 to 1978 in Egypt; and he is now involved with the role of governmental planning in new urban developments in third world countries. . . . **Joseph Pastic**, M.C.P. '68, was interviewed by his hometown paper in Massachusetts while on a brief stopover there. He and his family recently came back from a five-year stay in Guam and they are now destined for Kenya. Mr. Pastic explains that the United States, in cooperation with other countries, is trying to help Kenya rise above the level of subsistence farming — currently 90 per cent of the population, despite the fact that the crops are in world-wide demand. The aim is to develop a system of roads probably built over existing footpaths and of minimum standard — one lane and gravel — but good enough to make it possible for the farmer to sell crops at the market and start developing a surplus. . . . **Lawrence E. Susskind**, Ph.D. '73, head of the Department, is the principal investigator on a team of seven scientists from a variety of disciplines that has been awarded a \$70,000 grant to study citizen participation efforts in Europe. Another team member is **Donald Appleyard**, M.C.P. '58, now with the University of California at Berkeley. The group will study transit systems in Paris and Switzerland, local traffic planning in England and Holland, and neighborhood revitalization in Madrid, Copenhagen, and London. After a nine-month period they will present their findings in Washington, D.C.

XIII

Ocean Engineering

William H. Key, Jr., S.M. '70, has joined Klein Associates in Salem, N.H., where he will provide marketing and engineering support of side-scan sonars and sub-bottom profilers. . . . **Boyd Kendall**, N.E. '55, Captain, U.S.C.G. (Retired), professor of ocean engineering at California State University, reports that the university now has a three-course undergraduate naval architecture program, the only source in southern California for normal instruction in that discipline. . . . **William A. Kerr, Jr.**, N.E. '67, was promoted to the rank of Captain, U.S. Navy, in November of last year.



When he retired in 1978, Professor John Wulff's friends and former students honored him by establishing a lectureship in materials science and engineering, and this spring that lectureship brought together two long-time toilers in the materials vineyard: Professor Wulff (left) and William O. Baker, president of Bell Telephone Laboratories, who spoke on "New Technologies from Solid State Chemistry and Physics." (Photo: Calvin Campbell)



F. E. Low

Nuclear Science Director

Francis E. Low, Karl Taylor Compton Professor of Physics whose research and teaching in elementary particle theory have won international attention, is now director of the Laboratory for Nuclear Science; he succeeds Professor Martin Deutsch, who will return to full-time teaching and research after six years of administrative responsibility.

The Laboratory for Nuclear Science is the center at M.I.T. for experimental and theoretical work in high-energy and particle physics. It operates the William H. Bates Linear Electron Accelerator in Middleton, Mass., and includes the Center for Theoretical Physics on the campus. Programs under its aegis make use of high-energy machines throughout the U.S. and Europe.

Professor Low's name is associated with the Chew-Low equations, which were developed to describe the pion field in relation to the nucleus by Professor Low and Professor Gordon Chew of the University of California. He's been at M.I.T. since 1956, when he came as visiting professor before his faculty appointment in 1957; and he was director of the Center for Theoretical Physics from 1973 to 1977.

Management Seminar in France

"New Directions in Strategic Planning, Management Control, and Information Systems" is the topic of a four-day seminar planned especially for alumni of the Sloan School of Management, to be held at Jouy-en-Josas, near Paris, from June 30 to July 3.

Co-sponsorship is by the Centre de Recherches et d'Etudes des Chefs d'Entreprise (C.R.C.) of Paris; lecturers will include Professors Arnaldo Hax and Michael S. Scott Morton of the Sloan School and Christophe DePont and Daniel Froissart of C.R.C. The format will include interactive seminars, and enrollment is limited.

Peter P. Gil, Associate Dean of the Sloan

Thomas S. Kuhn, Science Historian, Comes to M.I.T.

A major new appointment in the School of Humanities and Social Science: **Thomas S. Kuhn**, internationally known for studies in the history and philosophy of science, will come to M.I.T. this summer to take a joint appointment as professor in the Department of Linguistics and Philosophy and in the Program in Science, Technology, and Society.

Dr. Kuhn is now M. Taylor Pyne Professor of History of Science at Princeton, where he is also a member of the Institute for Advanced Study. He is widely known as the author of *The Structure of Scientific Revolutions* (1962), which Walter A. Rosenblith, provost of M.I.T., describes as "an enormously influential work on the nature of scientific change. Professor Kuhn is a central figure in contemporary thought about science," Dr. Rosenblith said, making no effort to conceal his satisfaction in Dr. Kuhn's decision to come to the Institute.

Harold J. Hanham, Dean of the School of Humanities and Social Science, joined the chorus of praise: Dr. Kuhn will be "an enormous asset," he said.

Beginning next fall, Dr. Kuhn will teach a basic undergraduate subject on the philosophy of scientific development as well as graduate subjects in the philosophy of science and history of physics. By 1980 there will also be an undergraduate subject on the history of thermodynamics.

Professor Kuhn's training as a physicist specializing in solid-state science was at Harvard, where he received three degrees — B.S. (1943), A.M. (1946), and Ph.D. (1949). He turned then to the history of science, becoming assistant professor of general education and history of science at Harvard in 1951. He's been at Princeton since 1964.

School, explains the subject: "The shifting pressure on organizations from their external environment coupled with some changes in the management concepts and computer technology available to organizations have resulted in some interesting new developments in the fields of planning and control. These recent developments are proving to be powerful, and they offer insights to managers which are proving very helpful."

Further information about the program, for which the all-inclusive fee is \$1,400, is available from Dean Gil and from Jacques Bayle, Directeur General, C.R.C., 5 rue de la Liberation, 78350 Jouy-en-Josas, France.

XIV Economics

The **Padoa-Schioppas**, S.M. '70, were back at M.I.T. as visiting scholars last fall. **Tommaso** came most recently from the research department of Banca d'Italia in Rome; **Fiorella** was associate professor in economics at the University of Rome. . . . **George W. Shuster**, S.M. '69, has added a juris doctor degree from Yale to his credentials. In 1973 he joined the law firm Edward and Angell in Providence and stayed there until early this year, with the exception of serving one year as law clerk in the United States Court of Appeals for the Second Circuit. In addition to being part-time professor at Providence College and Bryant College, he now has assumed the position of general counsel and secretary of Cranston Print Works. . . . **William H. Gruber**, Ph.D. '65, is the co-author of an article in the February issue of *Chemtech*, entitled "Tomorrow's Management Today." Dr. Gruber is president of the Research and Planning Institute, management consultants, and is also the co-author of *Factors in the Transfer of Technology*, published by the M.I.T. Press. . . . **William D. Nordhaus**, Ph.D. '67, has returned to Yale as professor of economics from a two-year tenure with President Carter's Council of Economic Advisors. . . . **Jeffrey M. Perloff**, Ph.D. '76, is assistant professor of economics at the University of Pennsylvania and a consultant to F.T.C. and the Labor Department.

XV Management

Taft-Pierce Manufacturing Co. of Rhode Island has elected **Philip R. Marsilius**, S.M. '48 to the board of directors. Mr. Marsilius is president of Producto Machine Co. and director of its British and Canadian branches. Earlier this year he was appointed chairman of the Connecticut Business and Industry Association. . . . **Howard Mandelbaum**, S.M. '65, has been promoted to senior vice president at William Douglas McAdams, a pharmaceutical advertising agency in New York City. . . . A press release from Corning has news about two of our alumni: **Henry F. Frailey**, S.M. '57, most recently business manager for television products, takes on the newly created position of director of product excellence, with the intention to meet the demands of "rising public expectations and to guarantee the company's reputation for excellence worldwide"; **John R. DallePezze**, S.M. '67, is named manager of business development for the Electrical Products Division. . . . **F. "Hugh" Alderdice**, S.M. '67, has been promoted to manager in Lockheed's Space Systems Division.

Irwin I. Boris, '66, was recently named director of distributed systems at Honeywell. . . . **Eugene J. Eckel**, S.M. '62, became vice president for electronic parts in Western Electric's manufacturing division in March. . . . **Richard L. Terrell**, '58, retired vice chairman of General Motors Corp., has been elected director of a Chicago-based holding company, Esmark, Inc. . . . **Harold A. Shaub**, '57, president of the Campbell Soup Co., is one of the nominees to be elected to Exxon's board of directors. . . . **James J. Forese**, S.M. '59, vice president of I.B.M., has been elected to the board of directors of National Utilities and Industries Corp., a holding company. . . . From **Albert T. Camp**, S.M. '56: "Have been operating a complete farm and dairy plant for goat milk and dairy products since June, 1977. I serve the entire Washington, D.C., area; plan to retire from the navy in January, 1980, to run dairy full-time. M.I.T. visitors welcome."

Lindsay L. Livengood, S.M. '49, writes that he recently joined Thomas C. Major and Associates in California as associate broker specializing in land development, residential and commercial construction, and syndications. . . . **Benjamin R. Stahl**, S.M. '60, spoke on "Programming Con-

siderations" at National Engineers' Week last February. He is currently manager of executive education at Raytheon Data Systems. . . . **Robert E. Huber**, S.M. '61, has been promoted to vice president for national sales of A.T.&T Long Lines.

XVI

Aeronautics and Astronautics

Douglas P. Glasson, S.M. '76, is a member of the technical staff of the Analytic Sciences Corp. . . . **Stanley G. Rosen**, S.M. '70, has been honored with several awards: Outstanding Young Man of America; Outstanding Young Engineer of 1978 by Los Angeles A.I.A.A.; and Fellow of the Institute for Advancement of Engineering. . . . **W. Tom Edwards**, S.M. '71, is back at M.I.T. as a student in biomedical engineering in the H.S.T. program. . . . A concise report from **Robert F. Weiss**, S.M. '59, on the back of an Alumni Fund envelope: "President of Physical Sciences — an applied research company in Woburn, Mass., with over 40 employees, and growing; second term as member of the Lynnfield Board of Selectmen; wife Jane is director of medical records at Union Hospital in Lynn; four children." . . . **Jacob M. Wiedhopf**, S.M. '73, received his M.B.A. at Stanford and is now a management consultant at S.R.I. International (formerly Stanford Research Institute) in Menlo Park, Calif.

James W. Harrill, S.M. '64, writes that he is retiring from the air force and is about to begin a new career. . . . **J. Gary Reid**, S.M. '68, is assistant professor of electrical engineering at the Air Force Institute of Technology and was recently promoted to major. . . . **Dino A. Lorenzini**, Sc.D. '70, currently a student at the Naval War College, has been awarded a Meritorious Service Medal. . . . **John A. Schira, Jr.**, S.M. '62, has been promoted to colonel; he is an aircraft maintenance officer at Langley A.F.B. in Virginia.

XVIII

Mathematics

James R. McCord III, Ph.D. '61, lives in Georgia where he has been a consultant since 1971. His clients have included Georgia Power Co. on a project involving mathematical chemical analyses. . . . **Joel M. Cohen**, Ph.D. '66, reports that he has been promoted to professor of mathematics at the University of Maryland. . . . **Richard M. Soland**, Ph.D. '64, was appointed research professor in the School of Engineering at George Washington University last fall. . . . **Douglas A. Szper**, S.M. '73, writes, "I attained fellowship in the Society of Actuaries in November, 1978, and two months later was promoted to assistant actuary in the State Mutual Life Assurance Co., Individual Life Actuarial Department.

Happy parents are **Nancy Lynch**, Ph.D. '72, and her husband **Dennis**, Ph.D. '73 (chemistry). Their son Patrick Michael was born on March 12, 1979. . . . **Stephen H. Crandall**, Ph.D. '46, professor of engineering in the Department of Mechanical Engineering at M.I.T., has been presented the Trent-Crede Medal by the Acoustical Society of America. He was cited for his research in vibrations, "especially those aspects of random vibration associated with components and structural failure."

XIX

Meteorology

Ryland Y. Bailey, '52, is senior engineer with the State Corporation Commission of Virginia. . . . **David M. Garrison**, S.M. '72, is working with the National Weather Service and Air Weather Service on automating plain language and aviation-coded weather forecasts. . . . The east coast director of Florida Weather Service is **Henry Brandt**, S.M. '65.

The pure line is not straight
But takes the curve of men
The cycle does not circle make
Though it returns again

Electron paths are random
The snowflake's not complete
Why hunger after cubes
Where only edges meet?

The pyramid is perfect
Geometry of death
But nothing there embalms
The accidents of breath

The Greeks discovered sweetness
In lines that fool the eye
And we applaud the greatness
That's small enough to cry

Design the right thing straight
Neat paths across the lawn
And living footsteps stray
Beside, across, not on

Thus computation falters
And all abstractions lie
The human muscle alters
The straight to purity •

Beginning in the 1930s, William Chace Greene — who taught literature at M.I.T. from 1925 until his retirement in 1971 — tested himself against the challenge of writing a sonnet a day in the tradition of Merrill Moore. The resulting verses, which lay in an attic for nearly 20 years, have now been exhumed, rewritten, added to, rearranged, and brought into print under the title, Nodes On a Long String: A Life in Verse (Center Sandwich, N.H.: Harvest Press, 1978, \$7.95). The collection is "slantingly autobiographical," in the publisher's words — poems in many forms evoking experiences of youth, friendship, love, family, travel, and life itself. Many of Professor Greene's former students, remembering the warmth under a somewhat acidic facade, will find glimpses of an unforgettable character. (Poem from Nodes On a Long String, copyright 1978 by William Chace Greene, reprinted by permission)

Doherty Ocean Professor

Harilaos Psaraftis, Ph.D. '78, who will become assistant professor in the Department of Ocean Engineering on July 1, will hold the 1979 Henry L. Doherty Professorship.

His research under the professorship will be on the design of an emergency pollution response system for cleaning up "small" (100,000 gallons or less) oil spills at sea. Such spills, he says, pose greater long-range ecological and economic threats than the spectacular big ones: small spills are more frequent, and they tend to occur nearer to shore.

Dr. Psaraftis received S.M. degrees from the Department of Ocean Engineering in 1977; his Ph.D. is in transportation and operations research.

Fusion Expert to Nuclear Engineering

Jeffrey P. Freidberg, an authority in the application of magnetohydrodynamic theory to plasma fusion machines, has come to M.I.T. from Los Alamos National Laboratory to be professor of nuclear engineering.

He is also a member of the Fusion Theory and Computations Group at the Plasma Fusion Center.

Dr. Freidberg went to Los Alamos shortly after completing his undergraduate (B.E.E. '61) and graduate (M.S. 1962 and Ph.D. 1964 in electrophysics) degrees from the Polytechnic Institute of Brooklyn. Before leaving Los Alamos early this year he was director of the Laboratory's Plasma Theory Group.

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With the Alumnae

In November, 1979, the M.I.T. Faculty Club will show paintings by **Susan E. Shur**, '60, who runs her own technical advertising agency in Boston. Susan is particularly interested in the preservation and restoration of art works and has published and edited a magazine, *Technology and Conservation*, for the past three years. The magazine will co-sponsor (with the M.I.T. Historical Collections) a two-day seminar next October on "Scientific Examination of Works of Art."

Congratulations to Mrs. **Jean (Brenfleck) Pas-kowitz**, '73, who gave birth to a third son, Thomas Andrew, on March 6. Jean was President of the M.I.T. Club of St. Louis for the year that ended in April, 1979.

A group of alumae met on April 25 at the New York Alumni Center to discuss common career issues and ideas, following a recruitment letter sent to all M.I.T. women graduates in the New York area. The group anticipates that bimonthly meetings will begin in September with speakers of interest to professional women, and plans to produce "Network," a newsletter for the New York area.

A.M.I.T.A. held their annual meeting in early May, when: the major business of the meeting was election of officers and presentation of the A.M.I.T.A. Senior Award, a cash prize in recognition of high academic and professional work by senior women, to two outstanding members of the graduating class, Debra Myerson and Evita Vulgaris. The program highlight was an informal discussion with President Wiesner of the progress and status of M.I.T. women. Dr. Wiesner reviewed his impressions of the changes that have occurred for women at the Institute, noting that although the past ten years have seen increases in the population of women students and faculty, he was impressed by a problem which persists today: the concern that women students are not taken se-

riously. At the beginning of his tenure Dr. Wiesner proposed a recruitment drive which resulted in an increasing number of women at the Institute; they now comprise 20 per cent or more of entering classes; but he and his colleagues are now convinced that their efforts stopped too soon; he feels that alumnae have to exert their influence to maintain the positive climate for women. Laya Wiesner's involvement with women's activities and interests at M.I.T. served him invaluable as trusted input, he added, a situation recognized by many A.M.I.T.A. members who recall similar circumstances over the years.

The student award winners continue to display the highest in academic and professional performance. The A.M.I.T.A. award, originally established to demonstrate the first-rate performance of women at M.I.T. when circumstances were less favorable than today, now recognizes scholarship beyond grade-point-average alone, including research and other professional accomplishments. Ms. Myerson, a management major, spent a term at London School of Economics pursuing her interests in economics in an international setting. Beyond course work, she interned in government contributing an analysis of municipal finance which will serve as the basis for future debt policy recommendation for Massachusetts. She will continue her studies at the Sloan School next year. Ms. Vulgaris performed advance research in high-energy physics and in structure of materials at a level considered by her advisors to be at or above that expected of graduate students. She continues to carry on theoretical research, including the major planning and execution of the analytic effort. She plans to continue these activities in graduate school next year.

—Elizabeth Greene and Susan L. Kannenberg '61

Burning the Candle for Nuclear Power

After three years designing and building nuclear reactors for Combustion Engineering, **Andrew Kadak**, Ph.D. '72, decided that he could do more to assure the life of nuclear power by working on public opinion than on technology. So he took a new job as nuclear information officer for Narragansett Electric Co. in Providence.

"I wanted to get the industry more involved in making the nuclear debate more intelligent," he told Mark Patinkin of the *Providence Evening Bulletin*. "The public is going to have a say in this whole thing, and it ought to have all the information it can get." His job was to help provide that information — and in the process gain public support for a new nuclear plant in Charlestown, R.I.

Then came the Three Mile Island accident.

The reasoned debate he hoped to stimulate turned into shouting in the streets. There were even signs among some demonstrators, "Kadak Must Go!"

He won't go, he says. "I have faith in the technology," he told Mr. Patinkin. Even with the accident and everything else considered, "nuclear power is the best shot we've got to meet energy needs." How else, he asks, will we keep the lights on for our children?

Cognitive Science Center

Why does every human language we know on earth have structural similarities to every other language? Because, said M.I.T.'s Professor Noam Chomsky in a ground-breaking monograph called "Syntactic Structures" in 1957, certain basic structures, capacities, and operations of the human mind are revealed by such similarities.

Since then, scholars working on other cognitive problems — vision, speech recognition, psychology, and development — have come to similar conclusions: much insight into the workings and limitations of the human mind can be inferred from the common approaches which all humans take to such fundamental problems as these.

Now there will be a central focus for studies such as these at M.I.T., where they began over 20 years ago — a new interdisciplinary Center for Cognitive Science, whose administrative director will be Professor Samuel J. Keyser, Head of the Department of Linguistics and Philosophy. The goal is to provide an intellectual and administrative focus for workers following these ideas in such diverse areas as philosophy and linguistics, psychology, computer science and artificial intelligence, education, and medicine.



Norman E. Seavey, '99, knew a very different M.I.T. than students today. The Institute's academic buildings (left counter-clockwise) consisted of Walker (left) and the Rogers Building on Boylston Street in Back Bay. In the foreground is a horse-drawn railway. Professor Charles Cross taught electrical engineering. "He was short, plump and precise, and he had no hair on the top and back of his head." Professor Gaetano Lanza (below) taught mechanics and hydraulics. He joined M.I.T. in 1871 and remained for 41 years, 29 of which he spent as head of the Mechanical Engineering Department. (Photographs courtesy of M.I.T. Historical Collections)



My Life and Memories of M.I.T.

by Norman E. Seavey, '99

(We asked our oldest alumnus, age 102, about himself and his recollections of M.I.T. as he knew it in the late 1890s.)

My class was the last class in the last century, 1899.

My days at M.I.T., of course, were in Boston. The old Rogers Building and Walker graced Boylston St. The engineering building was in the rear of Trinity Church, and the gym was a wooden structure on Exeter St. All freshmen were obliged to

take military drill, for which we used guns from the State Armory.

Each professor had his own eccentricities. There was Professor Charles Cross who was in charge of electrical engineering, Course VI. He was short, plump and precise. The study of physics was required in several courses, and he was the teacher. At times he needed to illustrate the principles of physics by doing experiments, and the necessary apparatus would be on his lecture table. However, once in a while, before the class met, some bedeviled student would cut a wire or take out a screw, thereby putting the apparatus out of commission. Poor Professor Cross, I can see him now standing there in perfect disbelief.

Professor Lanza taught mechanics and hydraulics. He was a short Italian with a sense of humor. Each year, soon after school started, he and Mrs. Lanza invited his freshmen classes to an evening reception at their home which was near the Institute. He, over the years, had collected a table full of puzzles which were at the disposal of their guests. In class he would lecture for a while and stop to illustrate by telling a funny story. He did not get far with the story when we started stamping on the wood floor. His face beamed, thinking it was applause. But we had a different reason: we already knew the stories from upperclassmen since the same stories were used year after year. In those days, everybody knew what was meant by "Lanza's yearly jokes."

After graduation, I went back to M.I.T. to Professor Frank Laws for two years as assistant in the electrical laboratory. Then I wanted a taste of the practical, which was given to me by Stone and Webster who sent me to one of their power and light plants, the Minneapolis General Electric Co., where I remained for six years. When that assignment was over, I decided that I was through with the "public service" business.

My Dad urged me to carry on his business in Dover, N.H., and at that time I felt ready for it. I remained a wholesale and retail hardware man until I was 68 years old, when I sold out. It's still a hardware store but in the interim it has had four owners. The building itself has been a continuous hardware store for over 100 years.

While in Dover I was a member of the school board for ten years, and also a director of the Strafford Savings Bank for ten years.

Mrs. Seavey is in her 94th year and very well. It was our custom to spend portions of each winter in Florida. But with no store, we moved permanently to Hollywood, Fla. and then to Orlando.

I have enjoyed recalling my school days.

03

Our active half-dozen classmates appear to be enjoying their retirement in the remarkable "period of the nineties." We appear to be active disciples of the present day, "energy conservationists."

So happy comrades, continue the plain, daily, and systematic schedule so we will easily close the few remaining years to the desired goal of our 100 years of M.I.T. association. — **John J. A. Nolan**, Secretary, 417 Dorsey Way, Anchorage, KY 40223

08

Franklin Towle, who helped to persuade me to take up the duties of secretary of the class of 1908, has recently written as follows: "My record shows little out of the ordinary, I fear, but here it is: Fifty-eight years with the national insurance brokerage firm of Fairfield and Ellis (both Tech men), 40 of it as a partner. All this based on my course II at Tech, mill option, which included fire protection. While I have only one degree it has been much the basis of my business and social life and tells me 'the more education the better.' Hope you went to Florida this winter as usual. We stayed here because of Mrs. Towle's health, but I am fine and hope to stay that way."

I regret the necessity of reporting that since February we have lost two more members of the class. On February 23, **Howard B. Luther** died. Howard had a distinguished career in engineering education. As long as 1908 had annual class reunions at Cape Cod, Howard was a regular member of the small group who came to them. I don't have any information about his recent years, his surviving family or details of his death. I have written to his family but there hasn't been time for a reply. March 3 marks the death of **Miles Sampson** in Fall River, Mass. He had lived in Fall River for more than 55 years. His principal field of professional work was the design and manufacture of textile machinery. He was very active in the First Baptist Church of Fall River and in King Phillip Lodge. His nearest surviving relative is a sister. — **Harold S. Osborne**, Secretary, 375 Highland Ave., Upper Montclair, NJ 07043

09

Florence Luscombe is leading an active life — judging from the many newspaper clippings the editor gets with reports on her numerous speaking engagements. On the first annual women's Equality Day, Ms. Luscombe explained that she began her career in the women's movement at the age of 5 when she accompanied her mother to a suffragette meeting. This interest has by now led to extensive travels all over the country and to far away places like China and the Soviet Union as well. Ms. Luscombe estimates that she has made over 200 speeches on topics ranging from civil rights and world peace to women's liberation. Her home base is a cooperative house in Cambridge.

Arthur L. Shaw died in October, 1977. He was a civil engineer, specializing in water supply, and a partner in the firm of Metcalf and Eddy in Boston. He is survived by two sons and nine grandchildren. . . . **Benjamin W. Pepper** died on March 15, 1979. He was retired president and chairman of the Boston insurance agency, Dewick and Flanders; he leaves his wife and two sons.

Mayo D. Hersey died on September 5, 1978. He was a world authority on tribology — the study of friction in machines — and received a gold medal for his work from the British government in 1974. The techniques he developed to reduce friction greatly reduced fuel consumption in machines, something that was seen as especially valuable at that time — the beginning of the world oil crisis. Mr. Hersey received many other awards including the first Mayo D. Hersey Award from the American Society of Mechanical Engineers. During his career, he taught at M.I.T. from 1910 to 1922, at

Brown and Harvard, and worked for the National Bureau of Standards and the U.S. Bureau of Mines. At the time of his death he was back at Brown University as a visiting professor of engineering.

Kenneth T. Blood died on January 29, 1979. Two years after graduating from M.I.T. he received his appointment as a second lieutenant in the Coast Artillery. The appointment was the start of a military career that spanned two world wars and 37 years. Major General Blood was commanding general of the Southern sector and New England sector of the coast artillery defenses during World War II. He leaves a son, Colonel Kenneth T. Blood, a brother, three grandchildren, and nine great-grandchildren.

The class has donated \$50 to the North Congregational Church of Cambridge in memory of **Chester Dawes** who died on November 5, 1977. . . . The class funds amounting to \$1,795.11 have been donated to the Alumni Fund, according to the wishes of **Arthur W. Shaw**, president of the class.

Keyes C. Gaynor died on August 28, 1977; **Alfred Mullhaupt, Jr.** died in March, 1970; **Melville K. Weill** died on June 14, 1978. No further information is available. — G.L.

10

John B. Babcock, long-time secretary of the Class, is now retired and living at the Seaside Nursing and Retirement Home, 850 Baxter Blvd., Portland, Maine 04103. Last year he was awarded a Bronze Beaver for his distinguished services to the Institute, both as a member of the faculty and an active alumnus.

The Kiwanis Club in Revere, Mass., held a surprise 90th birthday party for **Arthur Curtis** in July last year. Among the many presentations made to him were citations from the city and from Governor Dukakis and the House of Representatives. Mr. Curtis founded the Ice Co. in Revere and eventually went into the oil business, a job that still keeps him working five days a week. . . . **Cecil K. Blanchard** writes that he is well and busy but had to sell his car at age 92, "time to quit driving."

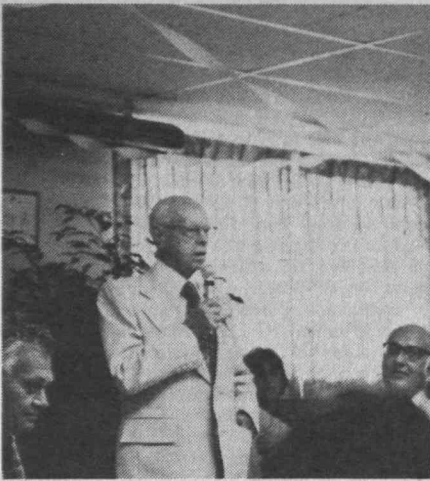
Frank A. Hayes died on July 25, 1978, in his home in Middletown, N.J. He was a prolific inventor holding over 50 patents. In 1930 he designed and patented one of the first automatic transmissions; the Austin Motor Co. in England was the first to install them. One of the last projects that captured his interest was the experimental installation of a wind tower on his front yard that would generate enough power to light his home. He hoped this would enable others in the area to follow suit and that his family would continue to benefit from the lower electricity bills long after he was gone. Mr. Hayes was born in Washington state when it was still a territory "so I can never be president," he used to joke. — G.L.

11

The request for news on the Alumni Fund envelope has inspired **Gardner C. George** to send us a newspaper clipping describing his latest adventures. In 1962 he moved to Coconut Creek, Fla., and soon became interested in his community. When annexation by neighboring cities became a threat, he chaired a committee to incorporate Coconut Creek as a city and became the new city's first mayor in 1967.

At the time of his 90th birthday in September last year, Mr. George was lured to the city's community center on a pretext by the police chief. To his surprise, around 200 persons were gathered there for a huge party in his honor. The celebrations were plentiful; there were skits throughout the evening featuring various episodes in Mr. George's life. The series began with a young woman and her infant son portraying Mr. George at birth with a nurse! After that a former city councilman took out an old army uniform (it still fits!) showing Mr. George in the Corps of Engineers during World War I.

Another highlight brought back the times when



First mayor of Coconut Creek, Fla., Gardner C. George, '11, addresses friends and well-wishers at his surprise 90th birthday party. Some 200 residents turned out for the occasion, named "This is Your Life, Gardner George."

Mr. George worked in a Mexican hydro-electric company during the times of the battles between the rebel Pancho Villa and the Mexican Federales. Coconut Creek's vice mayor played the rebel appearing in one of his customary uninvited visits to the company's mess hall. The final honor bestowed on the ex-mayor was the announcement that the Georges no longer live on N.W. 11th Street — that street now goes under the name of Gardner C. George Street.

Allston T. Cushing writes from his home in Lee's Summit, Mo., that his wife and he will have been married for 58 years this summer. He entered M.I.T. after having received his first S.B. degree from the University of New Brunswick in 1909. At M.I.T., he continued his studies to an S.M. degree in civil engineering in 1912.

Lloyd C. Cooley reports that he has been living in a 25-story concrete retirement home since 1975. The staff is good and he enjoys excellent health. Mrs. Cooley has to receive medication, but the results have been good.

Willis K. Hodgman died in November, 1977. Mr. Hodgman was a life-long resident of Taunton, Mass., and a former mayor of that city. He was also a former owner of Hodgman Manufacturing Co., started by him and his father in 1919. The company developed and manufactured mechanical devices for printing presses and fire protection equipment. In 1966, Mr. Hodgman sold his company to International Metals and Machines, remaining chairman of the board until 1974. He leaves two daughters, a sister, and grandchildren.

Harold F. Shaw died on March 31, 1978. He was designer and superintendent at the former F.A. Whitney Carriage Co. in Leominster, Mass., and president of Thayer Furniture Corp. He leaves a son, two grandchildren and seven great-grandchildren.

Osborne H. Shenstone died on January 28, 1978. He had lived in retirement in Florida since 1951 and leaves a son, J. C. Shenstone.

Merton W. Hopkins died in May, 1977; **Warren J. Simonds** died on October 8, 1978; **Walter C. Wilson** died on September 23, 1978. We have no further information on these classmates.

The Alumni Fund has received a donation of the remaining funds from the Class of 1911 on behalf of the 44 living classmates. It amounts to nearly \$500 and is given in accordance with the wishes of the last treasurer of the class, **Oswald W. Stewart**, who died on December 22, 1976. — G.L.

12

Jonathan Noyes has had his recovery from the double hip operation delayed. He broke two of his vertebrae. He wears a brace which he hopes to be able to discard about the middle of June. He is still at the Crestview Nursing Home in Bryan, Texas.

Regret to report three deaths of classmates: **John Hall** died on October 28, 1978, at the Hinsdale Hospital, Hinsdale, Ill. John spent his whole professional life in various aspects of public health. They included being the first full-time licensed Health Officer in both Long Branch and New Brunswick, N.J., a study in New Brunswick, Canada, which was a basis for the Provincial Health Department, service as Lieutenant and Captain in the U.S. Army during World War I as sanitary officer during construction of Fort Eustis, Va., and the embarkation port of Saint Nazaire France, later in the Health Departments of Nevada and Alaska, and subsequently Field Representative of the American Social Hygiene Association in a program of cooperation between the Army and state and community health agencies in four western states. Before his retirement, he was with the City Health Department of Philadelphia and the Engineering Bureau of the New Jersey Department of Health. John retired in 1960 and then acted as executive secretary of the New Jersey Health and Sanitary Association for ten years on a part-time basis. More recently his interests and activities were in the promotion of fluoridation of public water supplies for prevention of tooth decay. **Herbert Calvin** died on February 19, 1979, at Laguna Hills, Calif. He is survived by his widow. John was 88. **Walter Green** died on March 13, 1979, in Melbourne, Fla., having resided in nearby Palm Bay. An engineer for the American Brass Co. of Waterbury, Conn., he was a designer of factories and production equipment. Walter's interests included the Mattatuck Historical Society of Waterbury, of which he was president for many years; he was also active in the Federated Bird and Nature Societies, the Boy Scouts and the Appalachian Mountain Club. He leaves his wife, Elsa, two sons, and five grandchildren. — **Philip Dalrymple**, Secretary, 59 Boulder Rd, Wellesley Hills, MA 02181

13

As I reported in the March-April issue, I was spending some time in Southern California and therefore had to skip notes for the May issue. I had a wonderful visit; did all the things a tourist should do, and met some great people. Now I'm settled back into the daily routine of living on the coast of Maine, with our garden, daily walks and beautiful view of our ever-changing ocean.

Emerson L. Bray writes: "My best regards to you." ... From **Raymond B. Haynes**: "Greetings and all good wishes." ... **Herbert G. Shaw** writes: "We are well. I am active, drive the car yet. Leila is quite lame, uses a cane outside, but cannot walk very far. We wish you the best of health."

Mrs. Mollie Bakeman advised that her husband, **George W. Bakeman**, died December 4, 1978. She did not give us any details. ... We also regret to report the death of **Allan G. Waite** on January 5, 1979. "Born in Brookline, Mr. Waite attended the Stone School in Boston, was graduated from Harvard in 1911 and earned an advanced degree in mining engineering from MIT in 1913. He served at Kelly Field, San Antonio, Texas as a first lieutenant in the US Army Air Force in World War I. He was later transferred with the rank of major to Washington, D.C. After service in World War I, Mr. Waite attended Harvard Business School, then was employed in the brokerage business until World War II when he joined the US Army Ordnance as a civilian employee." (*Boston Globe*, Jan. 11, 1979)

Some time ago, we received a letter from Leon Keach (1917) asking if we had any information regarding his long-time friend, **Louis Conrad Rosenberg** as he had lost contact with him. The only information we had was a new address which we sent to Mr. Keach. We have now received the

following letter from Mr. Keach, which I am sure would be of interest to Louis' friends.

"The address you provided was just the ticket, and I am again in communication with my old friend. He is living at the Mountain View Convalescent Center, at Oregon City, and seems very happy and well, at almost 89, if a little weak in his pins. Many of us come to have a feeling that things aren't quite what they used to be in that department. He said that before moving to the Center, two years ago, he disposed of his property and artifacts, and donated an almost complete collection of prints, from his career as an etcher and drypointer, to the University of Oregon. It is called the Louis Conrad Rosenberg Collection, and they have issued a complete and excellent 89 page catalog concerning the gift that includes a biographical piece of considerable interest to me. On March 12th, Gail McMillan, who wrote the catalog and sent me a copy, added the following to her note of transmittal, 'Visiting with him last week we were pleased to see that he was in fine spirits, and that the catalog had revived several fond memories.'

I might add that the gift also contained drawings, watercolors, photographs and documents, and that I'm sure the catalog revived more than several fond memories, for Louis' relish of those good years was prodigious. A few years ago he even set up a prize to enable a talented graduate in architecture to travel in Europe so that he, too, might share the beauty and reap the enthusiasm that had meant so much to L.C.R. Rosenberg's M.I.T. traveling fellowship was taken in '20-'21, but his turn to etching involved several trips to Europe and North Africa, that stretched all through the Twenties." — **Rosalind R. Capen**, Assistant Secretary and Treasurer, Granite Point Rd., Biddeford, ME 04005

14

Fred Karns wrote in December that he and Margaret planned to spend the month of March on Marco Island, Fla., to travel on the Delta Queen from Cincinnati to New Orleans in May and to be with us at our reunion.

Francis Whitten died on March 6, 1979, in a hospital near his home in Medford at the age of 87. He was born in Boston, was with us in all four years, graduated with us in Course IV and went on to receive his master's degree. His early architectural career was with the Boston firm of John H. Bickford. In 1920 he joined the firm of Hutchins and French, also of Boston, was made a partner in 1924, and became senior partner in 1934. He retired in 1977. He had lived in his home in Medford since 1924, was a registered architect in New England and New York for more than 50 years, and had given to the Alumni Fund in every year since its beginning in 1941. Frank was a member of the American Institute of Architects, the Massachusetts State Association of Architects, the Boston Society of Architects, the Medford Historical Society and the M.I.T. chapter of Phi Gamma Delta. He was a Mason and a corporator of the Lawrence Memorial Hospital, in Medford. Frank leaves a son, Francis Whitten, Jr., of Stoneham; two brothers, Osborne Whitten, of Jacksonville, Fla., and Gen. Lyman Whitten, of Washington, D.C.; a sister, Ruth Stevens, of Topsfield; four grandchildren and five great-grandchildren. — **Charles H. Chatfield**, Secretary, 177 Steele Rd., West Hartford, CN 06119

15

This getting old and the slowing-down process that goes with it are no fun! But, **Bob Welles** out on the West Coast keeps going on high with his splendid letter to Joyce and me: (Great to hear from you, Bob, and keep up your fine spirit.) "I judge you are somewhat better than you have been, but maybe that isn't saying much. Mostly we don't get any livelier as we approach 90. I'm 88½. I have a friend here, a fellow Amherst alumnus, class of 1901, 11 years ahead of me, who became 100 last December. He is straight as

can be and really spry. He's the exception.

"I got back a few days ago from a trip down to La Paz in Baja, Calif. I flew down and joined my daughter, Carlotta, and her housemate, both occupational therapists, for the trip back up the peninsula (about 900 miles) in Carlotta's motor home. They had come by ferry across the Gulf of Calif. from Mazatlan, an 18 hour trip. We saw some gorgeous desert scenery, very mountainous in places, with blue water on both sides and more variety in cactus than seemed possible. The commonest kind, until we got within 150 miles of U.S.A., was a variety called Cardon that looks like a near relative of the Giant Saguaro that grows in Arizona. The Cardon are not quite as fine looking as the Saguaro, but about the same size, and they grow by the millions. Thick forests of them.

"In Baja, Calif. there are regions that in some years get no water at all and yet the ground is seldom bare. The plant life has to be such as can absorb water in a hurry when it is available, and make it last a long time if necessary. Flying over it at 20,000 feet you'd think the ground was bare. Come down low and you find the ground is seldom bare. But it is never light green. Here my peaches, plums and berries are all set, and we are busy thinning out the peaches. Under the orange trees the ground is white with fallen petals. It looks like a good year for fruit.

"The local M.I.T. Club is quite active, but without me. I have become too deaf to get anything out of a meeting in a big hall. We have a small group in Pasadena meeting very informally once a month that has been active for the last six years, and that I do enjoy. I've just gotten myself a dog for company, a German shepherd. He had already chewed up some of my best shoes, but he's smart as they come. He'll learn."

Ellis Ellicott's letter shows how active he keeps — wonderful! "I was very glad to get your letter of April 5th. I know something about the spring weather you have in your neck of the woods, because I have a stepson and wife who have been living in Skaneateles for about twenty years; he has recently retired and moved to a new house in Marion, Mass. Our spring here (Baltimore, Md.) has been about normal, but some of the early buds got nipped by frost. Our fishing group had a week in Florida followed by a week at a fishing lodge 30 miles off the coast of Belize City, British Honduras. It is a wonderful place, good accommodations, food and nice people."

Jim Tobey comes through with his usual good news. "I have just been rereading your column in the March/April Review, which is both profuse and interesting. I also had a letter from Joyce Brado who reminded me that I had overlooked the M.I.T. Alumni Fund, so I sent in a modest contribution yesterday. Wish it could be greater but the federal and state estimated income taxes take a big bite these days. My daughter and I were planning to return from Florida at the end of January but the weather reports from N.Y. and Maine prompted me to stay through February. We then spent four days in Tampa where my grandson Dave Hoisington and wife live now, and then drove home to Rye (N.Y.). I am busy here at Wainwright House, including a course in Spanish, which at my age no doubt will be very useful. Do you remember Justus Erhardt, the German, who taught us Spanish in the freshman year at M.I.T.? I am also signed up for the Dartmouth Alumni College next August 5-16. Last year I was the oldest student there, and should be this year. A grandson, Richard Hoisington, is getting married in Weston, Vt. on May 12, and I and my son expect to be there. So keep up the good work, behave, and accept my best regards."

Pop Wood always has a breezy and cheerful note for us — a great guy who has changed very little in all these years: "Charlotte and I send you our best for a fine Easter. Keep up the good recovery work! You sure had a fine class news item — seems like old times. Glad to hear about our other classmates. Sorry to hear about the ones who were taken ill. All fine guys. This old bum tries to keep a fine upright balanced life, mind always pure and clean unless influenced by others (am not saying who). Will hope to be down one of these days. Remember old man Pop to my

friends. Keep up the prayers."

Alton Cook — "the wolf" — with a "woof-woof" bark has slowed down to where he cancelled some of his traveling, but he still writes me a great letter, which, unfortunately, I can not repeat — what language he uses! ... **James Devine** died March 15, in Wilmette, Ill. ... **Hubert James** died Sept. 27, 1978, in Monongahela, Pa. The sympathy of our class goes to the families of these fine deceased classmates. — **Azel Mack**, Secretary, 100 Memorial Dr., Cambridge, MA 02139

16

As we write these notes, our 63rd Reunion is still ahead of us and the indications are that we will have our usual small but enthusiastic group. As a result of our letters soliciting attendance we had comments from many of our classmates. **Gene Lucas** wrote that he is now living in "Life-care Housing" in Hamden, Conn. ... **Harmon Keyes**: "Due to distance from Arizona, it will not be possible to attend. Regards to all classmates." ... **Hank Smith**: "Very sorry indeed not to be able to get up for this reunion but my kindest regards to all 16ers." ... **Frank Darlington**: "Sorry, my health is not good." ... **Val Ellicott**: "Again, I must regret, but I will try hard to make it in 1980." ... **John Fairfield**: "Alas, no." ... **John Gore**: "Have been in hospital and house-bound since first of year with the shingles. Best wishes to all." ... **Howard Evans**: "Age 85, in good shape for that age, but don't care for traveling." ... **Will Willetts**: "Hope reunion proves a great success, thanks for thinking of me. Cheers!" ... **Kem Dean**: "Thank you and good luck." ... **Don Webster**: "I am housebound with a bad back. Wearing a brace and use a walker in getting about. Doubt that I will be in shape to attend reunion. Best to all." ... **Will Wylde**: "We can only get north once a year and that has to be late August so sorry we cannot make it. Best regards." ... **Cy Guething**: "Very sorry that we can't make it. Our best wishes to all and keep breathin'." ... **Jap Carr**: "No chance now, but I may be able to arrange it. It's a long trip." ... This note from **Herb Ellis**: "Mrs. Ellis passed away last fall after a long illness. My health isn't good now but it is improving (tired heart). While I would like to attend the reunion I can't say so with any degree of assurance and will have to delay giving you a definite answer." We heard from another 40 or so without comment.

Unfortunately, we received word that **Merrill Pratt** died on November 28, 1978. **Howard Smith** died on January 8, 1979, "after 89 years of good life. He just plain wore out." **Charlie Lord** died on August 24, 1978; **Willard Brown** on April 14, 1979; **Theron Curtis** on April 22, 1979.

Leonard Besly's wife, Agnes, wrote: "We were spending the winter in Florida where he became ill and had to spend most of the month of February at the Naples Community Hospital or convalescing at our apartment there. I am happy to say that he is considerably improved and comfortable at home now in Red Bank. He sends his warmest wishes to all of you." ... From **Harmon Keyes**: "Personal activities of my wife, Alice, and myself have been maintained, although on rationed basis. Presently I am Life Member of National Society of Professional Engineers, American Chemical Society, and also Senior Member of American Institute of Mining, Metallurgical and Petroleum Engineers. Residence in Arizona has been continuous since 1924, being chiefly engaged in the research and development phase of metallurgical and mining enterprises. Assignments have been conducted at Cyprus Island, Nicaragua, and Guatemala, where primitive cultures mingled with modern metallurgical operations. In these developing countries the technology of U.S. and Canadian managements was seen to be an important factor in upgrading the native living standards. Alice and I will be celebrating our 60th wedding anniversary on June 27, 1979. Kind regards to you and the rest of the 1916 Class."

From **Charlie McCarthy**: "Thanks to a telephone call from Mary Barker, I learned of the death of our mutual friend and classmate, **Walter**

Binger, in time to attend the funeral service given for him at The Church of the Epiphany in New York City. It must have been of some consolation to Beatrice to find the church completely filled by friends who came to pay their last respects. I was very fond of Walt and enjoyed being in his company. He was always active and forward looking and, as you mentioned in a recent issue of the Class Notes, kept up his horseback riding almost to the end of his life." We quote in part from the *New York Times* of March 19, 1979: "Walter D. Binger, a civil engineer who designed the East River Dr., died March 19, 1979; he was 91 years old. Mr. Binger, a deputy city commissioner of sanitation in charge of engineering under Mayor Fiorello H. LaGuardia, supervised the construction of sewage-treatment facilities for Coney Island, Wards Island, and Tollmans Island during the 1930s. During World War II, he was chairman of the National Engineering Advisory Committee. A writer on engineering topics and other subjects, he was the author of *What Engineers Do: An Outline of Construction* (1928), and *What Engineers Do: Engineering for Everyman* (1938). An avid fox hunter, he was active in the sport until last year and wrote a book entitled, *Irish Fox Hunt*. Mr. Binger served as a second lieutenant with the Air Service Construction Division of the American Expeditionary Force during World War I. During World War II, Mr. Binger was a consultant to the British Government on engineering techniques involving civilian defense. In 1955, he was a consultant to the government of Iran on matters concerning that country's public works systems. He was a member of the visiting committee, department of sanitary engineering, M.I.T., and a fellow of the American Society of Civil Engineers. From 1952 until 1954, he was the society's national director. In more recent years, he was salaried president of the Jacob and Valeria Langelogh Foundation, a philanthropic organization specializing in the care of elderly people in nursing facilities. He retired from that position in January."

Keep breathing and keep your letters coming. — **Ralph A. Fletcher**, Acting Secretary, P.O. Box 71, West Chelmsford, MA 01863

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Recently, I was delighted to receive a letter from Dr. **Robert Mulliken** from whom we have not heard in quite some time. Bob is a professor of chemistry at the University of Chicago, despite his 82-plus years, and will retain this post as long as his health is good. He is noted as a recipient of a Nobel prize in Chemistry, earned, I believe, for his work on molecular spectra. We seventeneers will remember Bob's father as a professor of chemistry at M.I.T. in our day. His wife died in 1975 but he has two daughters. He came into possession of the old family homestead (circa 1800) in Newburyport, Mass. but has since given it to his elder daughter. His interests include art, Oriental rugs, and, especially, the stock market.

Another classmate from whom we have not heard in ages, **Albert Chase**, also recently gave us an account of his doings. He spent 15 months in the Army with the Chemical Warfare Service during World War I. After a few years with the Brown Co. of Berlin, N.H., Al went with the Foxboro Co. of Foxboro, Mass., until his retirement in 1966.

There he was responsible for sales to the textile industry. Al and his wife, Adelia, have one son, one daughter, seven grandchildren, and two great-grandchildren. All live nearby, and it keeps Al and Adelia young at heart, so says Al. What more could they ask?

A card from **Walter Beadle** from Santa Barbara, dated March 14, where he and Christine were enjoying a Vassar conference on "The Sea — A Citizen's Perspective on a Changing Frontier." Santa Barbara was an ideal setting for it and the program looked like one that would do credit to M.I.T. ... **Chester Ames** lives in Winthrop, Mass., right on the water. Mrs. Ames writes that Chet feels quite well but no longer ventures out. They hope that some of the "boys" will occasionally

drop in on them. They also want to be remembered to all. . . . **Jesse Rogers** has established a weekend pattern by visiting his brother in Marblehead and by stopping en route at Revere Beach to enjoy the sight of the Atlantic. . . . **Al Lunn** has been discharged from the hospital and has returned home although still confined to his bed.

Howard Melvin is a great help to me in digging out news from our classmates living in the Rockies and Pacific Coast areas. Although in his 88th year, he sure gets around. Recently his daughter-in-law's brother, from Wales, visited America for the first time and they all explored western Canada, Washington State, Oregon and California. Then Howard gave a 90th birthday party for his sister. This spring he plans a trip to Washington State and Oregon to visit his son's family. All this and golf too. . . . **Alvah Moody** and his wife are living quietly in Denver but enjoy visits from their children during the year. He will visit a daughter in June who lives in the Chicago area. Other than that, he will be staying at home. . . . **Ossie Holt** has sent in an interesting letter. He lives in Woodland, Calif. During the Christmas season, his wife, Florence, came down with a serious bout of pneumonia. She is now well recovered. On April 21, their grandson, Steven Throner, married Marilyn Stringer at Pacifica, Calif. It was the first family reunion since last summer. On April 26, Ossie and Florence celebrated their 60th wedding anniversary at the home of their granddaughter in Woodland. . . .

Art Gilmour says he doesn't like to write letters but has volunteered the information that he and his wife have celebrated their 56th wedding anniversary, have a son, three granddaughters, and one great-grandson. He has no desire to travel from their peaceful life in Haverhill, Mass.

After considering many country inns and resorts, it has been decided to hold our 62nd reunion on Oct. 16, 17, and 18th at the Sheraton-Boxboro. It is only about 30 miles from Boston. Despite its nearness to Boston, it is in a wooded area and remote from any other buildings. It is located at the junction of Interstate 495 and Mass. Rte. 111. You will be hearing further about it.

We regret to report the death of four of our classmates: **Clifford E. Lansil** died on April 7th at his home in Arlington, Mass. He taught electrical engineering at M.I.T. from 1917 to 1945, retiring as a Professor. He then joined the Gamewell Co. of Newton as a research and development engineer, until his retirement in 1960. He was a member of the Society of Professional Engineers. He leaves his wife, Marie, two daughters, a son and four grandchildren. . . . **Edward Sampson** died on Jan. 23, 1978. He was Professor of the Dept. of Geology at Princeton University. . . . **Richard P. Martin** died on May 12, 1978. He resided at 559 Lawrence Ave., Westfield, N.J. . . . **William J. Ahearn** died Oct. 31, 1978. Bill lived at 48 Cedric Rd., Centerville, Mass. He had retired from C. H. Cronin, Inc. He was a life member of the American Society of Heating, Refrigeration, & Air Conditioning Engineers. — **William B. Hunter**, Secretary, 185 Main St., Farmington, CT 06032

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It is good when classmates get together. I saw **Julie Avery** at the March meeting of the M.I.T. Alumni Council, and Julie is busier than ever. In particular, his new process for producing magnesium is past the pilot plant stage — and large scale production will be established in the next few months. A foundation has been set up for the license of the patent; M.I.T. will be the major beneficiary along with the Boston Museum of Science. Being busy agrees with Julie — he is enjoying hard work and good health. The next week was the occasion of the next Council meeting — I was delighted to share it with **Len Levine** and **Eli Berman** — both of whom had recently returned to these environs from their winter sojourn in Florida.

I enclose herewith a most welcome anecdote from **Harold Weber**: "I wonder how many of the class of 1918 remember the classes in German with Professor Blackstein. We were sophomores

and M.I.T. was on Boylston Street in Boston. We all loved 'Blackie,' a small excitable man of middle age. One of our classmates was Jim Todd, a tall, lanky boy from Kentucky. Jim was good-natured and well-liked by all of us. One day in the German class Jim made an error in translating and Blackie immediately stopped him. Jim said, 'but Professor Blackstein, I thought —' Blackie immediately interrupted him and exclaimed, 'But Mr. Todd, you did not think.' Several days later Jim was again translating when he made a mistake. Blackie immediately once again said, 'Mr. Todd, you do not think.' Jim answered, 'But Professor Blackstein, I thought I thought.' That stopped Blackie cold and as I remember he never again reprimanded Jim."

My New Year's letter prompted the following response from **Herb Lerner**: "Your card reading 'the Great Problem, Proposition 13 or the Welfare State, any ideas?' reminded me that I have been lax in the matter of keeping in touch with you. The term Proposition 13 is probably as good a battle cry as any other to arouse the populace to the need for strict economy and fiscal responsibility in government. In today's pandemic of disorder and violence, we see the need for a strong, tough government. And bear in mind that the term government means 'to govern.' When I was an undergraduate at M.I.T. under that great professor William Thompson Sedgwick, 'The Chief,' as they liked to call him, was fond of saying frequently, 'Order is heaven's first law.' For several thousand years, organized religion has been trying, not very successfully, to change man's animal nature. But the plain, unvarnished truth of the matter is that the genus homo is the same cruel, animal-like creature he was back in ancient times. Animal-like creatures have to be controlled and if a democratic form of government can't control them, then it must be done by other means, maybe at the point of a bayonet in the hands of a military dictator. For in today's world, make no mistake, democracy, as a system of government, is on trial. Religion also is on trial. So, maybe the clergy, of all faiths, should get out of politics and back into their pulpits, lest they find themselves demonstrating that Karl Marx was right when he observed that religion is dope for the masses. Getting back to Professor Sedgwick's unfinished quotation, let's see what that great English poet and philosopher Alexander Pope had to say on the subject, where in his Essay on Man, he wrote: 'Order is heaven's first law, and this confest, some are and must be, greater than the rest.' That is my opinion also."

Selma and I were most impressed with a service dedicated to the memory of **Julie Howe** on April 8, 1979 at the Wellesley Hills Congregational Church (where he had been treasurer for over 30 years). It was a most beautiful program performed in a distinctly professional manner. It was indeed a moving rendition of "The Faure Requiem" — a well-deserved tribute to a beloved and devoted human being.

Mal Baber has been spending part of the winter as usual at Hilton Head Island, N.C., and reports he and his better half are enjoying their vacation there.

I regret to report the death of **Samuel Barron** at North Palm Beach, Fla., on April 4. **Hall Nichols** died on March 27, 1979 in Falmouth, Mass. He leaves his wife, Evelyn, and three daughters. — **Max Seltzer**, Secretary, 60 Longwood Ave., Brookline, MA 02146; **Leonard L. Levine**, Assistant Secretary, 519 Washington St., Brookline, MA 02146.

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The planning for our 60-year reunion has resulted in some welcome notes on classmates. For instance a card from **Jim Reis**. "Sorry I won't be able to make it to our 60th, but I sure will toast the whole class on that day with special regards to **Don Way**, **Ev Doten**, **Larry Riegel** and **Buzz de Lima**." Jim writes further that he's aging pretty well except for his eyes that bind him to his home grounds where he knows his way around. And **Dick Holmgren** writes that he is sorry "we" will not

be able to attend the reunion. Another nice card from **Dean Webster** expressing regret that they are not in good enough health to travel from Arizona to Boston. Finally for now, a thoughtful card from **Capt. E. E. Saunders**, U.S.N. Ret., feeling it would be unwise to make this anniversary for which he expresses sorrow.

But as of this writing (May 1), some 24 people have said they will make the trip, anticipating a rebirth of old friendship and another look at M.I.T. after more than 60 years. I hope to be there myself, and these notes at a later date will tell you of the attendees and reveal my reflections.

It is with regret that I advise you from time to time of the passing of classmates. **Eaton Webber** of West Newton, Mass., was deceased on October 27, 1978, **Edward A. Richardson** of Bethlehem, Pa., on October 18, 1978, **Freeman H. Horton** of Bradenton, Fla., on November 24, 1978, and **Arthur S. Johnson** of Byfield, Mass., on February 26, 1979. Of these men I have particulars only on Horton, a graduate in civil engineering. He served with the Army Engineers in World War I. Then, as a professional engineer, he was responsible for numerous Army, Navy, and Air Force projects during World War II. His designs were realized in many jobs such as Union Terminal in Cincinnati, Ohio, the Tampa Bayshore Drive seawall and boulevard, the Florida East Coast Railroad bridge at Jacksonville, and indeed in numerous bridges and other public works. He was 81 years old and leaves a son and daughter both in Sarasota, Fla., and nine grandchildren. My future hope is to gather more such information relative to our classmates and incorporate it sparingly in these notes. — **Bill Langille**, Secretary, Box 144, Gladstone, NJ 07934

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Hopefully I shall catch a glimpse of some of you on Technology Day. Of course I need hardly remind you that a year from now will be our big year. Your reunion committee is already making plans and you will be hearing from us shortly.

A note from **Art Merriman** tells of the death of **Tom Orchard** some time last year. Tom served as business manager for St. Paul's Episcopal Church in Cleveland Heights and was active in this capacity for many years. After retirement he returned to Providence, R.I., and lived with his sister.

A welcome note has been received from **Lyman Whitten**, Major General, United States Air Force, retired, of 4319 Cathedral Ave., N.W., Washington, D.C. Lyman says that while his eyesight is getting a bit dim, he hopefully will be able to see us at the 60th! — **Harold Bugbee**, Secretary, 21 Everell Rd., Winchester, MA 01890

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A postcard dated March 5, 1979 from Mexico City signed by Helen and **Bob Miller** said, "We will conclude our 20-day visit at our daughter's which included five delightful days in Cuernavaca. Yesterday we had a nice visit by Elena and **Viviano Valdes**. Tomorrow we fly to Tampa where we expect to stay overnight with Graciela and **Helier Rodriguez** before returning home." (Question: Did the Rodriguezes attend the Fiesta in Mexico this year? I haven't heard.)

I reported last month that **Larcum Randall** had been in the hospital while I was in Sarasota and faced possible surgery. A letter from **Josh Crosby** tells me that leg surgery was performed and that Larc was in good spirits and expecting to go home to his beach-front apartment on Siesta Key. Josh also reported that **Allen Addicks** had had an operation on his leg, but was around and driving again and hoped to stop in and see the Crosbys in Sarasota. Your Secretary has learned by a telephone call to Kay Randall that Larc did get home, was getting around with a walker, had a fall and had to go back to the hospital, but was expected home again on April 30.

A good long letter from **Wallace Adams** commented on current news, the wonders of technol-

Inventing for Fun and Profit



by Robert L. Hallock, '22

Here in a nutshell is a successful inventor's advice for people who have creative ideas that need to be transformed into inventions: work hard, sell hard, and avoid overconfidence.

My father used to get up in the night to heat milk for my baby sister. One evening he decided to heat the milk before going to bed and wrap it up in towels. He found it still very hot in the middle of the night, so he decided to wrap up a potato to see what would happen. To his surprise he found that he had a baked potato in the morning. That was the start of his fireless cooker, of which he sold thousands.

My wife couldn't get the ice cubes out of the tray, so I thought of putting a lever on the tray and grind. When she didn't like to empty the cloth vacuum cleaner bag, emptying it became my job until I developed a paper bag with a closure. When steaks burned in the oven, I decided we needed a range with a glass window and an adjustable shelf. One does not have to be a genius to become an inventor. Even an accident can turn into a profitable invention. Just think of life's frustrations as opportunities. How do you keep a nut from vibrating off its connection, or how do you nail things to materials other than wood? Such questions have led to successful inventions.

Most inventions do not spring fully formed from the inventor's mind. Usually they are improvements to earlier inventions. For example, Thomas Edison was not the first one to invent the electric light bulb. Sir Joseph Swan carburized a film of paper into a wire form, placed it in a partial vacuum tube, applied electricity, and developed a light which burned out in a few seconds. Eighteen years later Edison carburized a thin strip of impregnated bamboo, placed it in a vacuum tube, applied electricity, and to his delight it glowed for several hours.

Robert Fulton, who is credited with inventing the steamboat, actually based his work in part on the discoveries of Henry Williams and Oliver Evans.

Samuel F. B. Morse's first telegraph had a maximum range of 40 feet. He then studied what had been done in the field of electromagnetism and was finally able to send a message ten miles. Then he was granted his patent in 1844.

These are but a few of the great inventions that came about after previous ideas had been partially developed. But in every

case there had to be new ideas to add to the old one.

Ideas Are Easy, Solutions Hard

Where do ideas come from? Some people claim that they come from the subconscious mind, some say ingenuity is inherited, others believe it is a God-given talent. I feel that a great deal has to do with having a mind-possessing patience, optimism, and interest in trying to do something better — even if it's only peeling a potato.

Ideas are much easier to come by than solutions. For example, to make a zipper that doesn't stick is a sound idea. But how to do it is the invention, and that takes effort, patience, and self-confidence. Ideas come from all kinds of sources. How often have you said, "I wish someone would make this work easier or better"? That is the starting point for a new invention.

Inventing is a creative process that cycles repeatedly from idea, to change, to temporary solution. The process multiplies as each interim thought demands its own experimentation and change. It is from grappling with such complexities of thought that the inventor arrives finally at the simplest of solutions that should have been all the while the most obvious.

In earlier years I used to believe that the technical knowledge gained through a college education was the most necessary ingredient for successful inventing. Now I realize that the background that I gained at M.I.T. had to be combined with a number of other basic elements such as analyzing the problem in depth, getting all the relevant information, and thinking deeply about the various aspects of the project. Judgments have to be made as to whether there is time to devote to a project and whether it is a worthwhile one after all. When the answers are positive, then you become more inspired for long and hard work.

Inventing requires patience, optimism and a desire to succeed. It's a matter of not becoming discouraged when an idea fails to work, but rather of persevering to figure out why it failed. Here an analytical mind can be of real help. When one is willing and able to follow through, a big percentage of ideas will pay off.

Almost all of the 30 or more successful things I have invented came after a period of discouragement. Sometimes I would think I must be an idiot to keep on trying; but then I would realize that I must be close to an answer, for a breakthrough had happened that way so often before. One handicaps himself when he lacks faith or confidence in his ability or is inclined to make excuses for giving up on a project. There are limits, but to be successful it is necessary to take risks and to push beyond what comes easily.

From Avocation to Vocation

Inventing can be treated as a business or as a hobby, and it can become very profitable and worthwhile. But can one afford to be a full-time, professional inventor, and how long might it take before royalties will start rolling in sufficiently for one to give full time to inventing? The answer is, in most cases, perhaps five or more years. So inventing should become a hobby or a spare-time job until one's royalty exceeds one's salary for several years.

I do not intend to discourage engineers and other potential inventors from working in the creative and research programs of companies. I do, however, discourage you from trying prematurely to sell your creative ideas until you are reasonably sure that your ideas will work and are saleable.

When inventing in your spare time, it is best to try to develop those inventions for which you can afford to make three or four different working models without interfering with your regular employment or causing financial difficulties, for it usually takes that many before you develop one that has appeal and will sell.

Turning Ideas into Money

You can protect an invention before spending money on a patent by proving your "date of conception" with a drawing and an explanation of how it works which is signed by someone other than a relative. You must also have proof of a "reduction to practice" by making a working model. And, finally, you need to show proof of "diligence." This requires that you work somewhat regularly on your idea and that you keep a record of

what you do. It is, however, necessary to file for a patent within one year of your first sale or publication.

Many people file for a patent before they really know the points that make their inventions new and novel. They seldom know these points from their first drawing or model. If the claims in your patent applications are hastily or poorly written, omitting important points of difference, others may find it easy to circumvent your patent.

Even though you have a good patent or proof of your early conception, companies are gun-shy when it comes to discussing the purchase of inventions, mainly for fear of conflicting developments. However, if you have proof of saleability of your product they are usually glad to negotiate whether you have a patent or not.

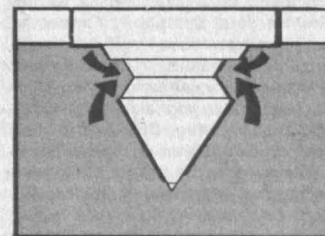
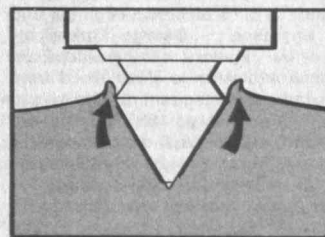
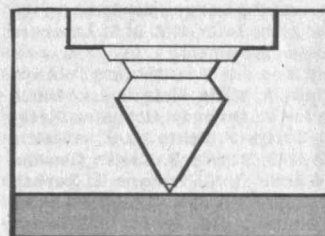
My method of proving saleability has been to make several models and to peddle them door-to-door or store-to-store until I found users who were willing to help me find out how well my models worked and how to make them so acceptable that people would recommend them to their friends or until a store wished to reorder. With marketability shown, it then became much easier to convince some company to buy my developed idea outright or on a royalty basis.

There are many other points of interest about inventing. But the most important advice of all is this: don't let your good ideas slip away, for you deserve the joy, satisfaction, and profit which inventing will bring you.

Robert L. Hallock studied mechanical engineering at M.I.T. with the Class of 1922, and ever since graduating he has been busy turning his ideas into inventions and turning his inventions into profits. He is the author of Inventing for Fun and Profit (New York: Harmony Books division of Crown Publishers, 1978, \$3.95) and is closely associated with the Innovation Center at M.I.T., to which royalties from the book are assigned.

"One of my inventions — the Zonolite fastener, a nail for anchoring the base ply of built-up roofing to concrete — is sold to W. R. Grace and Co. at the rate of \$1,000,000 worth per year." When driven into concrete, the two-piece stem of the fastener spreads, producing an inverted wedge. The nail configuration before and after installation is shown below (top).

"My latest invention — Metal-Tack (lower three figures) — has just gone on the market, and many orders have already been received for its use in fastening name plates to various products. Unlike the common nail, it drives into steel with a single blow of an ordinary hammer and holds up to 300 pounds."



ogy today, and reminiscences of student days. Said Walley, "Sitting, listening to TV arguments on the nuclear accident in Pennsylvania. I am amazed at how people can know so little about what they talk, that politicians are only interested in votes and that the news media desire to report trouble only and neglect facts. This morning Cincinnati paper had an editorial that was to my way of thinking: Get the facts and act with judgement. — The notice (enclosed) of Prof. Luther's death was one I had expected. He was in charge at M.I.T. summer surveying camp each of the three years I was there. He bought the canoe I had at camp. About 1923-24 he went to the Univ. of Cincinnati and headed the Dept. of Civil Engineers.

"I am continually startled at the things that have happened in the 15 years since I retired. *Civil Engineering* reported that 1979 is the 100th anniversary of the founding of the U.S.G.S. They started out measuring distances by wheel. Today they are measured electronically and the computers are mounted on the surveying instruments. Large maps today are made by pictures from satellites. Last week I read about the 'Ink-Jet' method of printing — speed beyond my comprehension. They can produce 5-inch-long lines of type at the rate of 45,000 per minute. — Well, all of this and I really have no class news for you." Thanks, Wally, write me again.

Class president **Irving Jakobson** came over and had lunch with Betty and me one day last week. He brought over the treasurer's records left by **A. Royal Wood** (deceased). I can report that the treasury is in a healthy condition. . . . One Alumni Fund envelope from Dr. O. **Kenneth Bates** reports "Excellent health and enjoying life. Taking trip to Egypt this April. Have 4 children, 11 grandchildren, and 2 great-grandchildren." Prof. Bates was head of the Math Dept. at St. Lawrence University until his retirement.

A soberingly long list of deaths was received this month: **Philip A. Willis**, Metairie, La., March 21, 1978; **Charles W. Maloney**, Cohasset, Mass., Dec. 30, 1978; **George F. Gokey, Jr.**, Charleston, S.C., Feb. 20, 1979; **Donald B. Carter**, Glastonbury, Conn., March 11, 1979; **Dana E. Kepner**, Denver, Colo., March 11, 1979; **Rodman McClintock**, Pittsburgh, Pa., March 7, 1979; and **Raymond A. Snow**, Raleigh, N.C., March 22, 1979. **Charles Maloney** worked for many years for Stone & Webster as chief electrical engineer and construction engineer. . . . **George Gokey** attended many of our reunions with his wife, Edie. He was personal secretary to Edsel Ford from 1923 to 1934, and superintendent of Bigelow's in Jamestown, N.Y. from 1934 to 1957. George was very civic-minded and served as president of Jamestown Family Service for 20 years and also president of Prendergast Library Board. . . . **Donald Carter** spent most of his career with Travelers Insurance Co. in cost control, budget and accounting work, retiring as assistant chief accountant. He loved music and was a former member of the Hartford Symphony Orchestra. After retirement, he played cello for 10 years with the Manchester Civic Orchestra. . . . **Dana Kepner** got his degree in sanitary engineering at M.I.T. He was an assistant professor at Harvard, an engineer for the Chicago Sanitary District and then Colorado's first state sanitary engineer. He entered the waterworks treatment equipment business, founding the Dana Kepner Co. in 1929. At our 50th Reunion, I learned Dana had written two short stories to entertain his grandchildren, and Dana sent me copies. He illustrated and published the stories. Your grandchildren would like them. . . . **Raymond Snow** worked for Carolina Power and Light Co. for many years as district manager. The sympathy of the class is extended to the families of these classmates. — **Sumner Hayward**, Secretary, 224 Richards Rd., Ridge-wood, NJ 07450; **Josiah D. Crosby**, Assistant Secretary, 3310 Sheffield Cir., Sarasota, FL 33579; **Samuel E. Lunden**, Assistant Secretary, Lyon Associates, 453 South Spring St., Los Angeles, CA 90013

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The excitement today is getting reservations for the June 8 Alumni Day lectures and luncheon. We hope to see you all at M.I.T. for our 47th Reunion. **Parke Appel's** correspondence has kept us up-to-date on many of the activities, but we could not catch up with all of his involvements in Venice, Fl.

William B. Elmer, 2 Chestnut St., Andover, Mass. 01810, has continued sending your Secretary an enlightened paper called *Ergo* containing a good discussion of our nuclear age. Bill is still as active as ever speaking from his platform in Andover on many current subjects, and sent a postcard from Tangier, Morocco, in March. Bill and Cathleen, with their 20-year-old son, celebrated his acceptance by Harvard Medical School. He also reports that his book on reflector design is now being typeset by John Wiley & Sons. His *VooDoo* slides shown to us at the 55th will be shown this year to the Class of '24. . . . **Horace W. McCurdy** of Seattle has written to several regarding his enthusiasm about Dr. Paul E. Grey for the President's Chair and has outlined his reasons. Mac has had a keen interest in Institute affairs for many years including his experience as Honorary Secretary starting in 1937 and Alumni Term Member of the Corporation from 1945 through 1950. He was elected a Life Member in 1963 and has had particular interest in the crew.

Roy Stone has sent a beautiful postal card from Oaxaca, Mexico, telling of meeting with the Mexico City M.I.T. Club, visiting Mitla, Mount Alban, and other areas before flying back to Tampa in March. . . . **George Dandrow** celebrated his 80th on May 12 and continues to "hang in there" with his usual pep and enthusiasm. We all wish George many more years of friendly activity. . . .

Donald F. Carpenter is continuing his interest in Class of 1922 Professorships. Don and Louise will take their daughter and family to Alaska early this summer before opening their home in West Chop, Martha's Vineyard. His hospitality latch is always loose. . . . A very complimentary article has been written about **Charles B. Miller, Jr.** in the *Charlotte Observer*, N.C. After retiring as vice-president of the Duke Power Co., he decided to distribute Mighty Midgets, a small but effective extra lock for doors. Charles is complimented as a go-getter with his background in civil and electrical engineering and as a Lt. Colonel in the Army. He does not reveal his golf score, but is enthusiastic about the game.

Mrs. Margaret Cooper of Delmar, N.Y. 12054, has written of our loss of **William E. Cooper** in 1977. She is happy to remember the good times of our 50th Reunion. . . . The sympathy of our Class is extended to the families of Lt. Col. **Harry Howland Fisk** of Green Bay, Wisc.; **George Piers Brookfield** of Forest Hills, N.Y.; and Rev. **Theodore S. Wray** of Springfield, Penn. . . . We also extend our sympathy to the family of **Clarke Turner Harding, Sr.** of Medway, Mass., who died in Orlando in February. He was a retired chemical engineer with Standard Oil Co. of New Jersey. He leaves his wife, Martha, two daughters, a brother and 11 grandchildren.

Here's hoping you all have lots of pep for your summer golf games and active vacations. Our greetings received indicate that the more physically active we are, the longer we can continue to stay with it. Good luck. — **Whitworth Ferguson**, Secretary, 333 Ellicott St., Buffalo, NY 14023; **Oscar Horowitz**, Assistant Secretary, 3001 South Course Dr., Pompano Beach, FL 33060

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Royal Sterling reports that our 56th reunion will be held September 7-9, 1979; place yet to be chosen. Classmates who attended any part of the 55th reunion will be sent letters containing complete information. Others who wish to have the information should request it directly from Royal at his summer address, 1340 Warwick Neck Ave., Warwick, R.I. 02889, and include any suggestions they may have.

Norman Weiss writes that he and Mary plan to



Senator Edward M. Kennedy (left) presents the Electronic Industries Association's Medal of Honor to Robert C. Sprague, Sr., '23, founder and honorary chairman of the Sprague Electric Co., at the association's annual Government-Industry Dinner in Washington. Mr. Sprague is the first man in the 55-year history of the association to receive this gold medal twice.

come to the reunion. They will celebrate their 50th wedding anniversary in August, and their grandson, Paul, will be married in June in Salt Lake City. . . . The presidential election was held in Ecuador on April 29 and Sixto A. Duran-Ballen did not win it (see November, 1978, Notes). **Atherton Hastings** writes that he is a consultant to the City Engineer of Florence, Ala., on problems of recycling and converting solid waste to energy, and he attended the Southeast Regional Conference of the Solid Waste Division of E.P.A. in Nashville. He works also with the Retired Senior Volunteer Program. He says further, "I think the *Technology Review* is about the most valuable publication I receive. I look forward to its arrival and congratulate the staff who put it out."

Robert C. Sprague, founder and honorary chairman of the Sprague Electric Co., was awarded the Electronic Industries Association's Medal of Honor at the association's annual Government-Industry Dinner in Washington on April 3. He is the first man in the 55-year-old history of the association to receive the medal twice, the first time being in 1954 after serving as president and chairman of the group. . . . A plaque was dedicated in memory of the late **John Ely Burchard** at a ceremony following the quarterly meeting of the Institute Corporation in March. Howard W. Johnson, chairman of the Corporation, presided; the speakers were James R. Killian, Jr., honorary chairman of the Corporation, and Robert L. Bishop, who succeeded John as dean of the School of Humanities and Social Science. The plaque, which cites John's considerable honors and accomplishments, hangs in the walkway connecting the Hayden Library with the main building.

The *Washington Post* reports the death of Captain **Horatio Clay Sexton**, an expert on submarine design and mine warfare, on December 26, 1978. He graduated from the U.S. Naval Academy in 1919 and took his master's degree in naval architecture at the Institute, affiliated with our class. Thereafter he was assigned to the Boston Navy Yard where he became assistant superintendent for hull ships. He taught for a time

at the Naval Academy and was coauthor of one of the first textbooks on aerodynamics. He saw active duty during World War II and toward the end of it directed the mine-sweeping division of the Bureau of Ships. In 1947 he was made commander with the rank of Captain of the Charleston, South Carolina Naval Shipyard, where he continually had many vessels under overhaul. His next duty was at the Electric Boat Co., Groton, Conn., as supervisor of shipbuilding and inspector of ordnance. He retired in 1950 to become associate professor of Naval Architecture at the Institute, and in 1953 joined the Central Intelligence Agency as a naval analyst. He retired again in 1961. Among his naval honors were the Legion of Merit and Honorary Commander, Order of the British Empire. . . . The Alumni Office reports the deaths of **Angelos A. Spiliotis**, on October 12, 1978, and **George J. Tzougros** on June 12, 1978. Angelos graduated in general engineering with our class and became Director, Crown Laundry Co., South Boston. George graduated in electrical engineering with our class. He was an electrical engineer for the Board of Transportation, New York City, and rose to assistant general superintendent of power for the New York City Transit Authority in Brooklyn. — **Richard H. Frazier**, Secretary-Treasurer, 7 Summit Ave., Winchester, MA 01890

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Your 55th Reunion Committee and Class Officers are trembling with excitement anticipating the Hullabaloo at the Exeter Inn, Exeter, N.H., on June 8 and 9. **Dick Shea** notes, "Looking forward to our 55th next summer." He did not say what date his gondola leaves Venice, Fla.

Regrets for the Reunion were received from **Max Ifield**, Albuquerque, N. Mex., April 7 when he and spouse returned from two months in California to find water heater burst, telephone out of order and plumbing inoperative. They decided on house-cleaning, interior painting, Lanai closure and new rugs, preparatory to July and August in Taos and a family celebration for seven grandchildren, parents, "live-ins" and off-springs. There is no gasoline shortage in New Mexico with surplus of coal, gas, and oil shale for export. Max expects that the coal under Indian reservations will make the over-livers more affluent than Arabs in time.

Foster N. Perry, a native Rhode Islander and your scribe's former boss at American Bosch Corp. (Springfield, Mass.), has retired to Southern Pines, N.C. He will not attend the 55th but sends regards and best wishes to former acquaintances.

Isabel, wife of **Silvio C. Massari**, notifies us of his death on March 25, 1979 in Dundee, Ill. He received his S.B. in mining engineering, served as Chief Metallurgist of the Association of Manufacturers of Chilled Car Wheels until 1942, when he entered the U.S. Army. He was released from active duty in 1946 as Lt. Col. in the Ordnance Dept. and joined the staff of the American Foundrymen's Society, later advancing to Director of Research. He received the Legion of Merit and the John H. Whiting Gold Medal for outstanding contributions to the ferrous metallurgy field. He was professional engineer, consultant, and expert witness after 1967.

Franklin O. Billings advises from the State of Washington that he was, "Recently elected as Commissioner (one of three) of newly created Port of Pend Oreille, a four-year term. My first public office sought and achieved at age 80!"

On April 28, our President, **Frank Randolph Shaw**, was presented a "Wellesley Award" in recognition of his longtime civic and humanitarian contributions, as a Wellesley resident, to the improvement of the community. Many efforts were not publicized but he headed the successful War Fund Drive years ago and now is Treasurer of the Council for the Aging and so-called R.S.V.P. for the elderly.

Your scrivener attempted to locate long-lost **George Parker** of Senior Picnic fame as a fully dressed swimmer at Pemberton. The envelope was returned from Hampton, N.H. stamped

"Addressee Unknown."

The Alumni office has a letter from Santa Anna, Calif., indicating the death of **Francis MacMillan** on February 15, 1978. He received his S.B. and S. M. in electrical engineering and circa 1967 was located in Jersey. We have no information on his career. **Bill MacCallum** and **Eleanore** have returned to their home in Cotuit on Cape Cod from Brookline after Bill had spent some months on daily visits to the Massachusetts General Hospital debunking the Three Mile Island radiation scare. He has reduced his weight and appears "fit as a fiddle."

The grapevine reports that **Luisa** and **Nish Cornish** will go to Exeter via air instead of the bus from Mexico City that wheeled them into the Florida Fiesta. — **Russell W. Ambach**, Secretary, 216 St. Paul St., Brookline, MA 02146; **Herbert R. Stewart**, Co-secretary, 8 Pilgrim Rd., Waban, MA 02168

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Bill Asbury was kind enough to send a page from a recent issue of "The Lamp" which tells of "the 15 virgins" of Baton Rouge. In 1927 a group of 15 young men, 12 of them graduate students and faculty in chemical engineering at the Institute, were recruited by Professor Warren K. Lewis to explore methods of producing oil from coal at what was then the Standard Oil Development Co. at Baton Rouge. The company old timers referred to the group as "the 15 virgins" because of their lack of practical oil industry experience. There was a sense of urgency in this program because at that time the forecasts indicated we would run out of crude oil early in the 1930's. These members of our class were in this group — **Bill Asbury**, **Marion Boyer**, and **Gene Hermann**. The Baton Rouge Exxon Laboratories observed a 50th reunion recently and Bill and Gene were present.

Milt Salzman really gets around with the Barbershop Harmony singing group. Late last fall he was on an interesting tour of the Hawaiian Islands visiting Oahu, Maui, Kauai, and Hawaii. The natives there liked this style of "old-time" harmony, he says. A note from **William Muschenheim** states that he is busy preparing a book on architecture.

A nice letter from **Henry Sachs**: although he has undergone two cataract operations in the past year, he says he is doing fine. He is still active in the insurance business so cannot stay away from New York too long. However, he has been able to get to warmer climes during the winter, having been to Mexico, Barbados, and Tucson, and managed to play some golf in each place. Henry is looking forward to attending the reunion in 1980.

My inquiries about the whereabouts of several classmates have brought results. A longtime friend of **Wendell Burbank** wrote to tell me that Wendell is living in Worcester, Mass., and is still active in community work in that area. A fine letter came from **Scott Emerson**, which was prompted by his having received a clipping from the February Review sent him by **Warner Lombard**, a fraternity brother: Scott is in South Carolina: Winea Plantation, R.F.D. 3, Box 78, Georgetown, S.C. 29440. He would welcome visits from 1925 friends when they are in the vicinity.

Perhaps someone can assist us in learning about a few more classmates. **Charles Kuhn**, architectural engineering, has not been heard from in more than 20 years. His last address placed him in Winter Haven, Fla. **Robert Quinn**, electrical engineering, seems to have disappeared over 20 years ago, too; last address was in Louisville, Ky. Bob was Kappa Sigma, and perhaps some of his fraternity brothers can help us. A third classmate, **Edward E. Piepho**, electrical engineering co-op, was last heard from in Tucson.

Over the past several months deaths of classmates have been reported to me, and it is my sad duty to pass on this information. **Nan Cunningham** has written that her husband **Frederick** died at Christmas-time, 1978, in Stamford, Conn., after a long illness. Frederick had his own company, Cunningham Industries, and his oldest son

Frederick, '63, succeeds him as president while David, '68, is treasurer. A third son, Richard, '67, is the Republican state senator from Stamford. All three sons, you will note, are M.I.T. graduates.

Jesse W. Green died in Pasadena, Calif., on September 23, 1978. Jesse came to M.I.T. as a senior in architecture and I'm afraid was not well known to many of the class.

Edgar Allen Stavert passed away on February 18, 1979, at the Goddard Memorial Hospital in Stoughton, Mass. His home was in nearby Randolph. Ed had been ill for the past two years. He was an electrical engineer for the Electrical Testing Laboratories of New York, retiring in 1970. He had travelled in the United States and Mexico supervising tests in manufacturing in those countries. He is survived by his sister, Mrs. Francis Leahy, and six nieces as well as eleven grand-nieces and grand-nephews.

William C. Shea died on January 4, 1979, at the Union-Truesdale Hospital in Fall River, Mass. He was born in Fall River and obtained his master's degree from Fordham University following graduation from the Institute. During World War I Bill served with the 26th Engineers in France and was discharged as a lieutenant. For several years he worked in the newspaper business and was suburban editor of the *New York Times*. He later became an educator, and when he retired 15 years ago was chairman of the Chemistry Department at the Charles Evans Hughes High School in New York City. From 1963 to 1976 he lived in Williamsburg, Va., before returning to Fall River. In Williamsburg he was a member of the Middle Plantations Club and St. Bede's parish where he served as rector. Funeral services were held in Williamsburg and burial was in Cedar Grove Cemetery there.

Word has reached me that **Walter C. Woodman** died on April 14, 1979, after a long illness. Walter had worked many years for Stone and Webster Engineering Corp. and after retirement was a volunteer during 1974 and 1975 at the M.I.T. Historical Collections where he cross-indexed by person and subject the stories in every issue of *Technology Review* from 1900 through 1951. He is survived by a sister, Mrs. Beverly Ottaway of Wellesley, Mass. — **F. Leroy (Doc) Foster**, Secretary, 434 Old Corners Road, P.O. Box 331, North Chatham, MA 02650

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Pigeon Cove is a great place to be in early May — especially if you happen to be recovering from a heart attack. Yes, in early April symptoms of the gripe indicated that a swim at the pool plus a soak in the whirlpool bath might chase away the gremlins (or beavers?) that were causing an aching neck and arms. It must have been the beaver that suggested "Instead why don't you go up and sit in the doctor's office?" — I did and in 15 minutes was being wired up to electronic monitors and slapped into "solitary" at the hospital in Gloucester. Having a meeting scheduled at M.I.T. for mid-May Ruth called to advise I'd be unable to attend and learned that Dick Knight '47, Secretary of the Alumni Association, had caught up with me and a couple of days later was in "solitary" at the Mt. Auburn Hospital in Cambridge with a similar problem. I'd smuggled a dozen postcards into the hospital and it didn't take long to get one off to him with a crack about "one upmanship." The banter continues. I was tossed out of the hospital after eleven days either for good behavior or for being an ornery patient (I asked no questions.) — Dick followed out I presume for similar reasons. However, we are now on our own and it looks as though the best idea is to obey the rules — the alternatives are not that appealing.

It is with exceptional pleasure when we hear of an award to one of our classmates these days. **Jim Killian**, **Stark Draper** and one or two others still remain high on the awards list but most of us are resting on our laurels. . . . Classmate **Art Underwood** recently moved into the limelight with an outstanding award which we can tell you about best by quoting from a S.A.E. news release: "Arthur F. Underwood, former Manager — G.M.



Art Underwood, '26

Research Laboratories, General Motors Corp., was recently honored by the Society of Automotive Engineers through election to S.A.E.'s Fellow grade of membership. Mr. Underwood was cited for a life-long career in the development and design of internal and external combustion engines. He is known principally for his research into lubrication phenomena and bearing fatigue through the development of test machines to duplicate engine stresses. Just established by the Society a few years ago, the Fellow grade of membership provides a means to recognize the outstanding engineering accomplishments of members. The Fellow grade is awarded to only a limited number each year."

One of the most popular characters in New England right now is a 220-pound, 18-year-old seal named Andre. He was found abandoned by his mother on a rock in Rockport (Maine) harbor and raised from infancy by the harbor master. His exuberance and size became a problem in the winter six years ago. He capsized some of the smaller boats in which he decided to sunbathe so he now is brought to the Aquarium in Boston to spend the winter. In early May he is trucked to Marblehead harbor and released for his 160-mile swim to Rockport, Maine. He was released this afternoon at 2 p.m. His record for the trip is 92 hours but in 1976 he took a leisurely 13-day trip. In 1977 he paid a visit to Pigeon Cove and climbed into a friend's skiff for his stopover. Naturally all of us are combing the sea with our binoculars for the little black head — the empty skiffs are also being watched.

We have a collection of back-of-the-envelope notes from various classmates: **Frank Cramton** tells us, "Retired by working harder than ever on consulting, church work and raising 12 grandchildren." ... **Bill Davidson** (Tampa postmark) comments, "We had our 50th wedding anniversary this year. Notes are still great." ... And very briefly **Walter Lobo** lets us know, "Still active in my consulting engineering practice." ... And reunion chairman **Don Cunningham** gives us a quick accounting of his activities for the year, "As a member of S.C.O.R.E. (Service Corp of Retired Executives) we work (no pay) with Small Business Administration to help companies in trouble, and individuals into business, also evaluate loans for S.B.A. During last year Mary and I visited the Mid-East, Austria, Hungary, France, and Japan." This collection of news items has been assembled far from Pigeon Cove in an auto seat-cover establishment in Chelsea and the car is now ready for Simon to ride in the back seat so we must say cheerio and please have a pleasant summer.

Late flash: Andre made it — 160 miles in 64 hours and 15 minutes, breaking his previous record by 17 hours. — **George Warren Smith**, Secretary, P.O. Box 506, Pigeon Cove, MA 01966

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I have a nice chatty letter from Paducah, Ky. bringing me up to date on **Les** and **Ethel Woolfenden** and their family. Ethel wrote it; I wish that the wives of some of our other pen-shy classmates would follow her example. Les has been keeping busy with unpaid jobs since his retirement from GAF nine years ago. He is president of the advisory board of the Lourdes Hospital in Paducah and president of a 100-plus apartment low-income housing development. He also be-

longs to Rotary and serves on the board of a local bank. That leaves Ethel to manage their acres of lawn; she also finds time to lecture on conservation and on bird feeding to clubs and Scout groups. Wild birds have long been one of her hobbies; they counted 68 species in one year in their yard.

Probably not by coincidence, their older son, Glen, is a professor of ornithology and university scholar at University of Southern Florida. He has lectured all over the U.S. and in many places abroad, including two lectures at Oxford, and is this year lecturing and doing research under two grants. He has two sons and a daughter at college — plus the daughter's horse. Don, the younger son, came home from Darwin, Australia, for knee surgery at Lourdes Hospital and had a very rough time. However, he was well enough to return to Darwin, where he works for the Australian government.

Charlie Smith in March sent me a seductive postcard from Cabo San Lucas, Baja California, to support his rave, "Beautiful mountains, beaches, wild roads, and deserts — 1,058 miles south of the U.S. border." In a subsequent letter, he tells me that they again spent most of the winter in Arizona and in April headed back to Monroe, Ohio, to stay until July, when they will be off for five weeks in Alaska.

Ed Chase mentions that for the past six years, **Allen Gifford** — Ed's roommate at M.I.T. — has been his neighbor in Plymouth, Mass. (Ed has been in Plymouth for 43 years.) Ed is completely retired, but Allen still does some consulting in civil engineering. ... **Jack Peters** phoned the other day to say that he is finally giving up work at his advertising agency (he has been on a part-time basis lately), and he and Virginia are building a retirement home in South Carolina, to be completed about September 1. When he goes, I shall lose the only fellow-Scarsdalian in the class. ... Heard from **Wes Meytroitt** for the first time in an age. He had just come out of the hospital (in April) after a bout with bronchial pneumonia and promised to write more when he gets his strength back.

Two '27 men who were my classmates in high school in Boston are among this month's correspondents. **Irv Hopkins** spent his entire career — 1927 to 1970 — with Bell Telephone Labs, working mostly on the physical properties of polymers. Now, he says, "I read quite a lot, service our appliances, keep the house (Millington, N.J.) in order, travel some, and fool around with Allan Gottlieb's puzzle corner." ... **Jerre Spurr** spends time delving into family history and "living in the past through participation in local parades in Bedford and Concord."

Fred Hooven, professor of engineering at Dartmouth, has been elected to the National Academy of Engineering, where he was cited for the "development of the first heart-lung machine, first electronic typesetting, first control system for unmanned flight, and an improved automotive front-wheel drive system."

Shorty Newell is living in Frederick, Md.; he retired in 1970 after 42 years with Turner Construction. ... **Doc Edgerton** has been elected by the Photo Finishing Association to its Hall of Fame. ... **Hank Kurt** writes from Brookville, Maine, "We like the winter here." ... **Luke Bannon** feels that he has a new lease on life after a successful cataract operation; he had been practically blind in one eye for several years.

Last fall, before I went into the hospital, I was in the midst of straightening out the key to the 50th reunion picture. Late as it now is, I think the job should be completed and will get back to it shortly.

I don't know how to thank all of you — my classmates and some of my friends from other classes — for the letters, cards, and phone calls expressing your sympathy and good wishes following my operation. As of early May, I am in pretty good shape, though still on chemotherapy. I have begun to drive the car, with one leg; get occasionally to dinner or a concert; cook my own breakfast; and manage a few simple household tasks. The doctors are confident that the cancer is licked. Marion has borne up wonderfully under

the strain of taking care of me and handling many of the things I had been doing during our 43 years of marriage. — **Joseph H. Melhado**, Secretary, 24 Rodney Rd., Scarsdale, NY 10583

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A letter from Asako and **Shikao Ikehara** in Tokyo says that they spent the New Year holiday period in Manila to celebrate the birth of a granddaughter. They appreciated the warm climate in contrast to the cold winter of Tokyo. ... A brief note from **Bob Kales** reports that he has become recently a director of Atlas Energy, Inc., a company engaged in oil production. ... We were pleased to have a telephone chat with **Augustus Rogowski**, who became a member of our class as a graduate student. Now retired, his early career was in the aircraft industry where he did stress analysis and structural design work. Later he joined the faculty at M.I.T. in mechanical engineering.

Honors of great distinction have come to two of our classmates. In Dallas on April 4 Helen and **Bob Harris** were principal guests at the annual dinner of the American Institute of Nutrition, where Bob was made a fellow of the A.I.N., in recognition of his life work in nutrition. We share portions of the press clipping: "The election honors Professor Harris' work covering many aspects of nutritional sciences. He initiated the annual series of books, *Vitamins and Hormones*, now nearing its 40th volume. He helped establish the Institute of Nutrition of Central America and Panama. He also established the Oral Science Training Program at M.I.T. which he directed from 1963 to 1970. His research was the first to show the value of phosphates in the prevention of dental caries. Professor Harris is the author of over 260 articles and chapters in scientific journals and textbooks." To you, Bob, our hearty congratulations on this well-deserved high honor.

A news release from the Smithsonian Institution, Washington, D.C., announces that "Brigadier General **Benjamin S. Kelsey** (U.S.A.F., Retired), a noted engineer and test pilot, has been selected as the second occupant of the Charles A. Lindbergh Chair of Aerospace History at the Smithsonian's National Air and Space Museum. Kelsey, whose one-year appointment began February 1, plans to do research on the history of American military aviation from 1927 to 1940, concentrating on the changes in aircraft design and in procurement and employment procedures." The news release then continues for two full pages describing the many outstanding accomplishments of our distinguished classmate. Ben learned to fly in 1920 at the age of 14. From 1929, when he assisted Jimmy Doolittle in the first test of instrument landing, until his retirement in 1955 Ben's work was in the country's military air service. During that time he had many important assignments both here and abroad. In 1959-60 he was Hunsaker Professor of Aeronautics and Astronautics at M.I.T. Ben will never lose his love of airplanes and flying. Many of you will recall how, at the Technology Day Luncheon last year and during the excitement of our 50-year gift presentation, Ben stood up and launched a tiny airplane into flight over the heads of the seated alumni.

Another gentleman who, we believe, is destined to be honored for his very special work is **Bill Hurst**. In a letter to **Jim Donovan**, Bill says that he is writing a book on his unique approaches to oil field engineering. This is a highly technical area and we suspect that most of us will find Bill's book not easy to read. Apparently the impact of his work is already felt in the industry and should contribute to improving domestic oil production.

We are very sorry to learn that **Paul Johnson's** wife, Dorothy, has died. Those of us who knew her have lost a delightful friend and join Paul in his loss. — **Walter J. Smith**, Secretary, 37 Dix St., Winchester, MA 01890

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John F. Dreyer writes, "Recently, a friend sent me a map of the M.I.T. campus as it looks now. I was

surprised to see its growth during the 50 years since we were there. My family is doing well, and I am enjoying research work in my own lab. One grandson is thinking of going to M.I.T. **Henry B. (Hank) Gibbons** moved from Texas to Connecticut when he retired. But now that his folks are gone, he has moved back to Texas. Regards to all." A brief note from **Donald S. Hersey** states that he is enjoying his retirement years (since 1967) immensely with his good wife. His major hobby is painting (art, not houses) for which some local recognition has been given. . . . **Stanley Darlington** writes, "I was briefly employed last November as a Regents' Visiting Lecturer at U.C.L.A. in electrical engineering." . . . **Sam Shaffer** has sent a note reading "Thanks for the birthday greeting! I am still enjoying my semi-retirement status. I am doing some financial consulting mostly locally, but also for a South African retailer with 500 stores in that country. Last December, Sybil and I tried a different mode of travel: going to a single country. We went to England and rented a flat in central London and lived like real Londoners. It was great! It beats all that packing and unpacking and hopping from one hotel to the other on a tour type of travel."

I received a post card from **Bill Bowie** (our class agent) and his wife Sally from Hong Kong. They left Albany (N.Y.) on March 10, for an extended tour of the Far East, visiting Hawaii, Japan and Hong Kong. They write: "One reason why you did not hear from us in Pompano Beach Fl., was our trip, which has been marvelous so far. We expect to be back home around April 30, rest a bit and get ready for our Big Event down at the Cape." . . . **Dexter T. Osgood** lists traveling as one of his hobbies and goes to prove it by his deeds! Last year, he and his wife Pauline went to Antigua, took a motor trip around California and Nevada, visited Lake Tahoe, Reno, Yosemite National Park, Kings Canyon and Death Valley. They spent some time during August in the White Mountains of New Hampshire (Dixville Notch). In November, they returned to their favorite resort in the Virgin Islands, Little Dix Bay, followed by a Caribbean cruise and a trip through the Panama Canal on the "Love Boat."

David F. Bremner writes, "In 1963, I started to develop a hobby for my anticipated retirement: breeding, training and showing German shepherd dogs. I sold my business in December, 1977, and I am pursuing my hobby. I find myself busier and more tied down than when I was working full time, but I love it." . . . **Ted Malmstrom's** Florence has sent me a note from Hawaii where they have been spending their winters for the past several years. They have a daughter and grandchildren living there which is the great attraction besides the climate. "Ted is just not able to get around well," the note continues. "He is somewhat improved by coming here, but I am sorry to say that we will miss our 50th Reunion much to our regret. We have thought a lot about the possibility of attending, but it does not seem practical. As I mentioned in my last note, we plan to move to Hawaii. We are returning home on May 1 to put the house up for sale. It is a great comfort for us to be near one of our daughters and three granddaughters. Our very best wishes to all the members of Class of 1929." Ted lists his hobbies as: Florence, golf, girl watching at Waikiki Beach, and watching his new apartment being built.

Laurence D. Luey writes: "Natalie and I lead a quiet life; we play golf and make occasional auto trips. I also try to keep up with financial matters and business conditions which effect our lives. Occasionally, I have the pleasure of seeing **Amasa Smith**. He has been an important man in Birmingham (Ala.), which is my home town too. For many years through his business associations, he has been involved in civic and charitable organizations. Indicative of Mace's popularity, he was made president of the Country Club of Birmingham, a spectacular dining and social club. A recent letter from **Rolf Zurwelle** indicates that he and Polly have sold their farm in Maryland and moved to Walhalla, S.C., where they are building a house. Rolf is continuing his engineering research, design and development work, which he enjoys."

Dick Piez writes: "I haven't got much to report

except to express my appreciation and gratitude for your thoughtfulness in remembering my birthday. I am also thankful for your efforts to bring our classmates closer together through your notes in the *Review*. Last year, we had a fine trip to Europe for over six weeks, visiting France, Switzerland, Austria, Germany and Holland. The weather was mostly good and people were very friendly and helpful everywhere we went. Warmest wishes to all."

Anthony Standen's latest book is on astrology, which he terms is "arrant nonsense. Forget your sun sign — it's utter improbability." He had a passive interest and intellectual curiosity in astrology, started to research the subject thoroughly, and came out anti-astrologer. . . . I have a note from **Bill Shannon** which reads: "Here is a belated thank you for the birthday greeting I received from the Class of 1929. I retired in 1973, the same year my wife Christine passed away after a long illness. My daughter-in-law's aunt and I got married in June, 1975. We are enjoying retirement life very much. We spend February and March in Venice, Fla., and one month during the summer in Chatham (the Cape) and make occasional visits to my son's house in Alexandria, Va. We have taken two trips to England and Ireland, and we enjoy fishing and golfing."

In February, I received a telephone call from the wife of **Kenneth L. Horgan** stating that her husband, who had been looking forward to attending our 50th Reunion, was seriously ill and was unable to attend. Yet he wanted to wish all his classmates happiness and a long life. Then I received another call from her saying Ken had died on March 16, 1979. Upon graduation, Ken secured a position with Westinghouse and remained with this corporation for his entire professional career. After a year and a half in their management training program in Pittsburgh, Penn., he was transferred to the New York office, where he remained until 1963, holding a variety of management positions. A promotion in 1963 brought him back to the Boston area as New England Zone Sales Manager and ending his career with the Educational Division in Pittsburgh, Penn., in 1970 after 41 years of service. His retirement years were spent in Coral Springs, Fla., where he pursued a variety of activities, including golf and gardening. He is survived by his wife Ellen T., two daughters and a grand-daughter.

I regret to announce the deaths of the following classmates: **Norman V. Ballou** of Dublin, N.H., in January, 1977; **Leonard Stievater, Jr.**, of New Smyrna Beach, Fla., in August, 1977; **Alfred N. Lawrence** of Lawrence, N.Y., on June 8, 1978; **Wheaton W. Kraft** of Fort Myers, Fla., in August, 1978; **James N. Latimer** of Grand Junction, Colo., on September 11, 1978; **W. Bailey Sellers** of Greensboro, N.C., on January 5, 1979, and **Gus Colarusso** of Boston, Mass., in January, 1979. — **Karnig S. Dinjian**, Secretary, 10 Ancient Highway at Plaice Cove, Hampton, NH 03842

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Those of you who have memories better than mine may recall that about a year ago I included in the Notes an item about **Alfredo Gutierrez**, formerly of Mexico City, who has settled in Garmisch-Partenkirchen, Germany. On April 20, without prior warning, Alfredo popped in to see me at the office and brought me up-to-date on his activities, in particular, the fact that he was just completing a trip with his family through Canada and the northeastern United States. As previously reported, he is still interested in trying to form an M.I.T. Club in Germany, but has had only a limited success so far.

By a coincidence, Alfredo's visit occurred on the day before the reception held by the Fairfield County, Conn., M.I.T. Club in honor of Dr. Wiesner. I suggested that Alfredo and his family attend and he readily agreed. This gave me an opportunity to meet Alfredo's charming young German wife, as well as his attractive sons Achim (13) and Michael (10). Incidentally, I believe that Michael Gutierrez at age 10 is probably the youngest child of a

1930 M.I.T. Wedgewood plates for sale. Colors: dark red and white. Campus views include: Airplane View of the Main Educational Group; Lowell Court; Pylon of Building One; Pratt School of Naval Architecture and Engineering and Dormitories in the Rear of the President's House.

Anyone interested is encouraged to write: C. N. Weiss, 13A Ware St., Cambridge, MA 02138

member of the Class of 1930. Alfredo plans to return next year for the Reunion and will doubtless report to us on his organizing efforts at that time.

George Nakashima is still designing and manufacturing furniture in New Hope, Penn. Both his daughter Mira and his son Kevin help him in the business. It appears that he does a certain amount of overseas business in Japan and India, as well as selling his furniture in Mexico. . . . **Tony Savina** kindly sent me a clipping from the *Stamford Advocate* of March 19, 1979 telling of an award that **Dick Chindblom** received. The award was presented to Dick by the Men's Club of St. John's Lutheran Church at their 30th annual "Man of the Year" dinner for his efforts on behalf of the Church and the Men's Club. Dick was described in the article as a "freelance script writer" who had recently received a Gold Award at the N.Y. International Film Festival. . . . **John Moriarty**, who retired about six years ago from Gulf Oil Corp., remained active as a consulting electrical engineer until about a year ago when a heart attack slowed him down. He and Etta live in Port Arthur, Tex. . . . **John Newsom** lives in Orlando, Fla., where he owns and operates his own business, the Newsom Oil Co., that distributes lubricants throughout central Florida. His son and one of his sons-in-law help him in the oil business. John has been active in municipal affairs as a City Commissioner, Zoning Commissioner and member of the Library, Salvation Army and Planning Boards. He complains that nobody comes to Orlando until they retire and that he hasn't seen a classmate for 40 years. However, he apparently plans to make up for this deficiency by attending the 50th Reunion next year. . . . **Horace Myers**, like **John Newsom**, is still active as a salesman in central Florida. Although he retired from full-time work in 1969, he has for the past ten years handled certain sales accounts for Fife Florida Electric Supply which sells lighting and electrical supplies in the Tampa area. For some 25 years Horace has been active in amateur radio, presently holding the call sign N4CM. He would like to hear from any other radio amateurs in the class and says that in general he is on the air at 1100 hours each Monday, Wednesday and Friday at 7175 KC.

We have at hand notices concerning the deaths of three more of our classmates, **John Ginley** in East Walpole, Mass., on January 4, 1979; **Robert Schwyer** in Milliflinton, Penn., on May 17, 1978; and **Frederick Turnbull** in Rockville, Md., November 20, 1978. Unfortunately, no details are available, except for the fact that **Fred Turnbull** was a fellow patent attorney who was in practice in Washington as of about two years ago.

Supplementing the brief item on the 50th Reunion in the December, 1978 issue of the *Review*, it has now been confirmed that the reunion will be held at Chatham Bars Inn on Cape Cod beginning on Sunday, June 1, 1980. It is anticipated that most of those attending will arrive during the course of the afternoon. There will be a buffet supper that night, followed by a class meeting to receive reports of officers, elect new officers, and consider any new business. The movies of prior reunions will probably be shown after the business meeting. It is contemplated that the daytime activities on Monday and Tuesday will comprise sports and sightseeing. There is a golf course and tennis courts at the Inn and other golf courses not far away. The banquet will be held Monday evening and Philip Morrison, an Institute professor and one of the world's outstanding astrophysicists, will be the speaker. A clam bake



Norman Fitzgerald, '31, visits the ruins of Monte Alban during the 1978 Mexican Fiesta.



Attending with their wives the Class of 1931 mini-reunion in Bermuda are (top from left) Ken Germeshausen, Howie Richardson, Randy Binner, Claude Machen, and Tom Jones.

Also shown (with wives) are Art Lutz, John Swanton, Henry Hartwell, Harry Landsman and Gene Branca.



is scheduled for Tuesday evening and on Wednesday we move to Cambridge for various on-campus events. Further details will be given in future issues. — **Gordon K. Lister**, Secretary, 530 Fifth Ave., New York, NY 10036

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Only two from our class attended the Mexican Fiesta this year, **Norman Fitzgerald** and yours truly with Helen. The M.I.T. Club of Mexico City did an outstanding job in making arrangements, not only in Mexico City but also in Oaxaca where we visited the historic ruins of Monte Alban and Mitla. The initial announcements didn't mention the most spectacular event encountered during the Fiesta, an earthquake that really shook us up while on the 20th floor of the hotel in Mexico City. Members of our class who didn't attend the Fiesta really missed an outstanding job.

In the notes for our last issue, I noticed a typographical error — **Cliff Harvey's** amateur call is given as WL1RF; it should have been W1RF. The schedule with **Fred Elser**, KH6CZ, is at 10.00 p.m. our local time on Sunday evenings, 14,020 or alternatively 14,002 Khz. . . . A note from **Tom Pureka** says that the M.I.T. Club of Cape Cod has become the meeting place of M.I.T. retired alumni as well as other active alumni. Tom says they are a big help in keeping the alumni in touch with M.I.T. Admiral **Cato D. Glover** writes that he has retired as a full admiral and divides his time in his home in Camden, S.C.; and his lovely wife's home in Columbus, Ga. They have been happily married for three years and spend some time traveling all around the world. . . . **Hank Ahlberg** is 25 to 30 percent retired but still remains in the management consulting business active in industrial plant locations all over the U.S. and some foreign countries.

Dick Ashenden is 10 percent retired and also spends considerable time sailing. . . . **Maurice Ayers** is retired but has furnished no additional information concerning his activities. . . . **Gene Branca** is retired but does spend time as an instructor at Northeastern University just to keep his hand in. He stays in the Boston area during spring and summer, plays lots of golf, and winters in Florida. It surely was a pleasure to see him and Mary at the mini-reunion. . . . **Mason Burrows** is retired, likes sailing, is active at the division level of the Coast Guard Auxiliary, has a pottery shop at home and is teaching adult education courses in ceramic technology for art potters. . . . **Jim Byrne**, also retired, occasionally does a review of paper on Guayule rubber products. Others who reported they are retired without furnishing much additional information are **John Cleveland**, **Phillip Frink**, **Ben Hazeltine**, **Al McClure**, **Spencer Prentiss**, **Gus Rynalski** and **Art Smith**. **Hal Davis** claims to be 99 percent retired, although he is director of the Chelmsford Historical Society, Historic District Commission, and clerk for the First Parish Unitarian Church. He summers at Winnepesaukee, works around the house, always seems to be busy, and sees **Al Dowdan** once or twice a summer.

Although retired, **John Dodge** reports that he is still working on a revision of *P.S.S.C. Physics*, the high school text originated at M.I.T. in 1957; likewise two other courses, ham radio, backpacking in summers only, music, extensive travel in Europe, Central America, and South America where he tries to keep up on his Spanish. . . . His mechanical and electrical home shop keeps **Emmanuel Fournier** busy, even though he is 90 percent retired. Awarded the Don Kern Award, 1978, **Charles Gilmour** is still a self-employed consultant in heat transfer, electronics, and appliance repair. In addition, Charles says he cruises, gardens, and shovels snow. . . . **Ed Goodman**, also retired, likes downhill skiing, tennis, gardening, camping and travel through the U.S. and Canada by car. He would be happy to see any classmates coming to or through Williamstown.

Furniture refinishing, chair caning, travel and caring for the property owned in the Caribbean keeps **Hal Gurney** busy. . . . Still working, **Ralph Hamilton** relaxes with golf and travel. . . . **Nels**

Haskell reports that he is retired and says his hobbies are his grandchildren and some travel. . . . **Don Houghton** is retired and travels via motor home. . . . **Howard Huntress'** interests include intrafamily traveling, music and the U.S. Power Squadron. . . . **Stu Knapp**, retired, winters in Cokesbury Village, Del., and summers in Southport, Me.

Dick Kropf states that he is still working, one of the few in our class. . . . Besides having numerous relatives, **Alex Kuhn** is studying piano, gardening, reading, writing, and working on a book about learning to play the piano after you're supposed to be "over the hill." Needless to say, Alex is retired. . . . **Bob Martin**, retired, has a new home in Florida and just returned from a month in China, covering 350,000(?) miles visiting 117 countries. . . . **Bryce Prindle**, 67 percent retired, includes photography, organ, and travel over the Cape Cod canal among his hobbies. . . . **Tom Pureka**, although a part-time real estate broker, is retired and spends some time fishing, golfing and traveling.

President of Q.E.D./Seaver Lab. doing research and development on solar energy with the objective of finding an alternate to rock storage systems, **Charles Seaver** has converted his house to a solar energy lab. He reports that he is enjoying the challenge but has yet to find the pot at the end of the rainbow. . . . **Shel Smith**, retired, lives a quiet life in Falmouth. . . . After retiring, **Morley Taylor** spends his life golfing, sailing, hunting and working in community life. . . . Another retired boatsman is **John Vasta**. . . . **Ken Wischmeyer** is still an active managing partner in an architectural company, enjoys golf and travels worldwide but sees very few classmates. . . . **Bill Dodge** seems to worry more about his golf score now that he is retired.

Other retirees include **Ben Mesick** who is working on his memoirs after returning from a six-week air-sea trip of South America; **Henri Turner** with several hobbies and some travel in the U.S. and Canada; **Don Sinclair** who is just back from five weeks in Florence and a two-week cruise in the eastern Mediterranean. He comments that Americans were very popular in Egypt just after the signing of the peace treaty. . . . A forgiving wife after 38 years keeps **Henry Randall** in line, helping other elderly types. His hobbies include reading and cruising on Chesapeake Bay. . . . **John Harrison** says he is 50 percent retired but I find that hard to believe because he oversees two owned hardware stores and conducts a one-man campaign against economic illiteracy and compulsory unionism. Good luck in your business enterprises and campaigns, John. . . . Still another retiree, **Henry Hartwell**, lives happily between Wilmington, Mass., and Tallahassee, Fla.

The mini-reunion in Bermuda, organized by Polly and **Ken Germeshausen**, was a huge success. Among those present were: Peggy and **Dick Ashenden**, Hope and **Randy Binner**, Mary and **Gene Branca**, Dorothy and **Dave Buchanan**, Ella and **Emile Grenier**, Connie and **Henry Hartwell**, Charlotte and **Ed Hubbard**, Naomi and Dr. **Dan Johnson**, Minnie and **Harry Landsman**, Alice and **Art Lutz**, Jean and **Claude Machen**, Hester and **Ted Morrill**, Frances and **John McNiff**, Loretta and **Enio Persion**, Evelyn and **Howie Richardson**, Louise and **John Swanton**, as well as Helen and yours truly. Tom Jones, of M.I.T., was the principal speaker at one of the best banquets ever attended by anyone.

Hope and **Randy Binner** are still busy curling when Randy isn't consulting or traveling. . . . **Dick Ashenden** still looks about the same as he did during our undergraduate days. It was a pleasure to meet Mary and chat with **Gene Branca** after all these years. . . . Dorothy and **Dave Buchanan** report they still love the northern climate, skiing, golfing and gardening.

Gil Ayres is 90 per cent retired, does some consulting, serves as part-time clergyman, spends time at both his home in New Jersey and his New Hampshire summer place. . . . **Dave Bernstein** is still working. . . . **Randy Binner** is doing part-time consulting, is busy with curling, and travels to Ireland. . . . **Dan Connelly** is retired and has time now for his boating. **Jerry Cook**

reports that he and his wife travel to Europe each year. They are golfers; also they attend the Boston Symphony in New York, the museums, etc. . . . **John Fricker** is retired but is the director of two companies. His hobbies are ham radio and guitar and lute making. . . . **Glenn Goodhand** retired from Boeing last year, has golf and Little League for recreation, and the stock market for interest and possible profit. He lives in Florida in the winter and Canada in the summer.

Don Grieco is retired, does some traveling, and reports that he has seen **Gabe Cristofalo**, **Henry Baratta**, **Cliff Walker**, and **Fred Damiano** in recent months. . . . **Clem Hamblet**, 95 per cent retired, does some gardening in his spare time. . . . **Marjorie Heath**, retired, has compiled, "Welcome Home to Deering, N.H.," the town's 200-year history. . . . **Naomi** and **Dan Johnson** have just returned in their motor home from a trip to Florida, New Mexico, Arizona, and California. . . . **Murray Lalone**, retired, has hobbies which include traveling. . . . **John Langmaid**, retired, sails, golfs, and fishes. . . . **Bill Litreal** is retired. . . . So is **John MacBrayne**, who since retirement has been to France, Greece, Egypt, England, and now Maine where he is president of Camden Rotary, and member of the public library board and Megunticook Golf Club. . . . **Al McClure**, retired, lists golf and travel. . . . **Carroll McCulloh**, also retired, lists fly fishing, reading, bridge, and poker. . . . **Gene Macoy** is 90 percent retired with a paying hobby — theatre lighting. . . . **Leon Osinski**, retired, has hobbies of woodworking and travel. . . . **Jack Parker**, retired, lists travel, gardening, and painting. . . . **Win Spencer** retired from General Electric in New York City, where he was manager of Process Control Engineering Services, and moved to Plattsburgh, New York, where he built a new home and has been busy with senior citizens' activities, A.A.R.P., and the advisory board to the county office for the aging. He is also on the state staff of his church as an adjunct area minister for northeastern New York state. He reports that **Clifford Smith**, who retired from DuPont a couple of years ago, had a serious stroke and is now in a nursing home in Waynesboro, Va. . . . **Charlie Terwilliger** retired from the advertising business six years ago and now operates three businesses full time. He has traveled to Wyoming to his daughter's and to Florida to his son's as well as to Germany and England on business.

Cliff Walker is retired, living in a condo overlooking the Halifax River in Daytona Beach, and travels occasionally. . . . **Harold Wilson** retired, has a quiet life on his farm in Bolton, Mass., and fishes in the Florida Keys in the winter. . . . **Sam Janney** is retired and says he'd like to see any classmate coming his way; he lives in Gloucester, Va., near Williamsburg. He's building model engines — steam, gas, and Sterling — in addition to photography. . . . **Fred Jelen** is a radio operator (amateur, first class, and commercial). He's also into boating and photography and conducts many seminars on cost engineering. He hasn't seen a classmate since the 25th Reunion. . . . **Larry Barnard**, retired, says he's rattling around in the old house with plenty of room for guests. All five children and seven grandchildren were there for Christmas. . . . **Clarence Ekstrom** is retired; travels. . . . **John Spalding**, retired, spends his summers in Yarmouthport and winters in Florida. . . . **Frank Baker**, retired, keeps busy with his home workshop and a large lawn. . . . **John Hollywood** still works as a consultant, hikes, operates ham radio, plays piano, and teaches Sunday School. . . . **Bill Moody**, 29.17 per cent retired, golfs, gardens, and travels, mostly in the USA. . . . **Doyle Northrup** is retired but gets into home improvements, swimming, surf fishing, traveling, and visits retired Air Force friends, and friends from his career in nuclear detection. . . . **Curtis Brown**, retired, is catching up on reading, church work, and loafing. . . . **Gordon Brown**, retired, spends his winter in Tucson and summers in Meredith, N.H. His hobbies are photography, doodling, and traveling. . . . **Fred Elser** is retired but working on his Ph.D. at the University of Hawaii. By amateur radio he keeps in weekly touch with **Ed Worden**. He made a 7,200-mile

motor trip on the mainland last spring. . . . **Howie Richardson**, our class president and corporate director of the Institute, is still busy as director of several companies and travels a great deal; he went to Russia last year. . . . **Jack Lane**, still works as a consultant. He made the one specific comment on all this: "This was an odd ball survey."

John Swanton is responsible for much of the above information which resulted from the study he made of the Alumni Fund contributors. As of April 15, 1979, a summary of the information he received (72 percent replies) shows that 77 percent are retired, 14 percent are 50 to 90 percent retired, and 9 percent are still working. Four percent are bachelors; five percent are widowers remarried; and five percent are divorced and remarried. The summary indicated an average of two children each and three-and-one-third grandchildren. **Bill Moody** reported 12 grandchildren for the record, and **John Swanton**, **Mario Caputo** and **Howie Richardson** reported 11 grandchildren each. **Harold Wilson** has the record with two great grandchildren and **Glenn Goodhand** and **Art Fuller** both one each.

It is always sad to report the death of our classmates. **Elliot F. Childs** passed away on February 11, 1979, and **Lester MacFarland** on December 31, 1978. No further details were given. **John William Smith Jr.**'s death was reported by his wife, Dorothy, to whom we extend our sincerest sympathy. Dorothy writes: "Jack had been ill for a long time, so his death on March 19, 1979, was not a shock to us, although we sadly miss him. We wish he could have had more years to enjoy his retirement and to watch his grandchildren grow up." Jack is survived by his wife, Dorothy Somers Smith of Portland; a son, Donald A. of Cranston, R.I.; two daughters, Mrs. Malcolm D. (Sara) Tobey of Marshall, Minn., and Linda S. Smith of Middlebury, Conn.; and five grandchildren. — **Edwin S. Worden**, Secretary, P.O. Box 1241, Mount Dora, FL 32757; Assistant Secretaries: **Ben Steverman**, 3 Pawtucket Rd., Plymouth, MA 02360 and **John R. Swanton**, 27 George St., Newton, MA 02158

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Our class President **John "Nick" Flatley** sends the following message to us: "We are approaching our 50th Reunion in 1982. Several suggestions have been made that we have an interim reunion in Williamsburg, Va., or Mexico City in the spring of 1980. The class officers would like to get a quick response to these suggestions. Would the class actives in Boston, New York, Washington, Atlanta, Chicago, San Francisco and Seattle take it upon themselves to organize informal luncheons? The purpose of these luncheons would be two-fold: to test out the interest in the interim reunion plans, and to talk up the Class Gift for 1982, thus giving **Bob Semple** some support in his task of organizing the Class Gift campaign. The class has enough funds to pick up the tab in the amount of \$100 to \$150 for each meeting. Write to **George Kerisher**, Class Treasurer, 41 Fieldstone Rd., Westwood, Mass. 02090 — and tell him of your requirements. Send the results of your meetings to **Mike Castleman**, the Class Secretary. Don't delay! Let's hear from you."

The M.I.T. Alumni Fund has sent me quite a bit of information concerning our classmates. **Ira Bach** writes that he is currently the administrator of the Illinois-Indiana Bi-State Commission. He also is the Chairman of the Commission on Chicago Historical and Architectural Landmarks. His book *Chicago On Foot* is in its third edition from Rand McNally, publisher. . . . **Robert S. Prescott** is taking life easy in Phoenix, Ariz. The Prescotts share their two acres with numerous rabbits, occasional coyotes, and many birds. . . . **Phil L. Bruce** is enjoying his hobbies which include astronomy, electronics, and model railroading. Phil, how about a long letter with more details? . . . **John Lawrence** makes the news again by being re-elected to a four-year term on the board of directors of National Life Insurance Co. of Vermont. John moved to Dallas, Tex., in 1957. There he is the President of J. Lawrence, Inc. and the Chairman of the Executive Committee

of Dresser Industries, Inc.

After one year in his new home in Florida, **Dan Danforth** can report his retirement is all that he hoped it to be. The Danforths play a lot of golf, garden, ride their bikes, and just relax in the wonderful Florida weather. . . . **Robert E. Moore** has moved and no longer shovels snow or cuts grass — and he doesn't miss it one bit. His son is the Program Director of Channel 6, Philadelphia. . . . **F. R. Russell** tells us that he retired from Exxon Research and Engineering Co. in 1971. He then taught for three years in the local technical high school. He is now retiring from the Boy Scouts after 50 years of activity. He hopes to pursue hobbies of shooting and amateur radio. . . . In January, 1978 the Ojai Valley Chamber of Commerce named **Royal B. Jackman**, as 1977 Man of the Year in recognition of his major role in obtaining a Senior Center and in reorganizing HELP of Ojai, a social service organization which sponsors the Ojai Valley Retired Senior Volunteer Program. He was also commissioned as an Honorary Deputy Sheriff for Ventura County, Calif.

Last reminder to all you golfers. Be sure to participate in the Class of 1932 Golf Tournament. You must play 18 holes on a regulation golf course in July. Turn in your attested score card to me with your handicap. Let's all play no matter how good or bad we may think we are. — **Melvin Castleman**, Secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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First off this time around is a much-needed pair of corrections, both for the same man, **Ben Liberfarb**: in a recent set of Notes, I spelled Ben's name wrong. And to add to the confusion, I misread his story, and announced that Ben had been in physical education since graduation. Ben has been in physical science education; quite different. He taught in various levels — high school, college, and continuing education — and reached the academic level of Associate Professor. I sure appreciate his feelings following such a blunder, and I offer my sincere regrets.

The National Academy of Engineering, the highest professional distinction that can be conferred on any engineer, tells us that our own **Edward W. Kimbark**, has been elected to membership as of February 28, 1979. Ed is a consulting engineer at Bonneville Power Administration at Portland, Ore. . . . **Ellery Clark** and his Louise phoned me from Port Everglades, Fla., to say that they were aboard the Queen Elizabeth II and had stopped here as part of a Los Angeles to New York City trip, via the Panama Canal, with many stops en route; west coast of Mexico, the Caribbean, etc. . . . We have a readable handwritten letter from **Warren G. Webster**, who writes that he and Elenora are spring cleaning, and practicing "Pitch and Putt," preparing for later golf. He says that he and El still hold lively discussions on advanced calculus (she graduated from Smith in math, cum laude), which of course is wasted on me. They still do a lot of tutoring on a no-charge basis; math, inorganic chemistry, Middle Ages history, and just about anything, even if they have to study up beforehand. . . . Every once in a while one gets a message from classmates who do not write too often, if ever. **Phil Cook** comes through with his first to me that I can recall, and it is sweet to add a new one. Dated March 15, Phil had just returned from Florida and hastened to drop me a line. Seems that he has been retired for eight years, and spends about four months of each year traveling, and the remainder sailing, gardening, and relaxing, presumably both in Wilmington and Florida. Many sincere thanks, Phil; write again.

Leona and I had a most enjoyable visit with Edna and **Jim Turner** at our home early April, and they ran against an annoying gas problem driving north. Jim says that they got all the gas they needed to get home, but stopped twice as often to buy it. Although United is on strike, and fuel is short, so far most folks get north by air with little inconvenience, and we live in hopes of taking off

May 8. Jim sure looks well, as does Edna, and she says that she is back to top notch again.

Again we hear from the irrepressible **Mal Mayer**, who is still in Washington, D.C. with SCORE as Director of Foreign Trade, but will finish his stint early in May and will return home to Maine. The most interesting part of the message is the card — an 1861 hand-colored lithograph of Mount Vernon — really a great litho. . . . **Bill Gray** comes through with an Alumni Fund capsule, which says that soon after the 45th he and Nancy moved into a new geriatric house, with the help of a good builder. They are now established in the mountains of Central Virginia. He writes: "I am expanding my boxwood and azalea nursery, and as time permits and need dictates, do some consulting in research and development as trustee of the Palisades Institute, New York City." Thanks, Bill. . . . **Harry Summer** has been retired for some long time, but he rehired with Bell and Howell as one of the troops, on a contributing basis. He went on a group trip to Egypt, but could not establish a phone connection with Mustafa. So, Musty, how's this short, pithy note for your classmates. Harry greets all of us and his friends of many years. . . . We have a fine note from **Walt Duncan**, who writes that he will be in Exeter, May 24 to 26, for his 50th Reunion at Phillips Exeter, and (imagine this) he asks my permission to phone me while there. Gee, that's great, and he can get down to see the farm, one mile north. Further, **Red Williams** and **Pete DuPont** were in the Class of '29 at the same school. Maybe they will show up. Sure will look for your call, Walt, and thanks.

It runs in my mind that we have already reported the death of **Robert W. Olsen**, of Winter Haven, Fla. Bob passed away in February, 1979, and is survived by his widow. For years he had been Professor of Citrus Research and Education at the University of Florida, Lake Alfred School. Our class offers our sympathy and best wishes to Mrs. Olsen.

Some will note that this tome is rather sketchy for news from the retired and not-busy classmates. You don't need a secretary? Why not say so. It sure ain't easy for me with one eye. Nuff sed!

I'd like to bring up one more item, or editorial rather. It has occurred to me that we may have many classmates who are in rather advanced years, and who are housebound or even bed-bound. There is no way for me, as Secretary, to hear very much of our unfortunates. But, some of you may well know of such cases, and if you do, why not drop me a line, so that we can arrange to have our boys get a letter once in a while. Heck, you were friends while at school, so why not now. I take a case in point: **Emmy Norris**, of whom I have written several times. I hope some of you laggards have dropped Emmy a line. **Henry Kiley** is sort of housebound, with rather a severe case of some kind of asthma. With proper care, he does well, but, a note or two annually may well help a bit more. I know I would feel kindly towards any missive under those same circumstances. Heck, I do anyway, that's all. And, note the short column this time and please get around to saying what you are doing. I am authorized to announce that the 50th Reunion committee will meet again, May 18, at the Alumni Office. More later and best to all for a fine summer, a thought in which Leona joins me. We will be at the farm May 8. — **Warren J. Henderson**, Secretary, Fort Rock Farm, Exeter, NH 03833

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Last fall we reported on **Art Conn's** retirement after 35 years with Amoco Oil Co. Well, it didn't last very long. Now comes an announcement that he has formed a consulting firm, Arthur L. Conn and Associates, Ltd., to work in the field of new energy technologies (particularly the production of liquid and gaseous fuels), guidance in the management of research and development, and information systems planning. It seems he hardly took time for a breather before starting in again.

In one of the reunion returns, **John Newbegin** comments: "Can't make it. I'm now working for

A.N.P.A. Research Institute as consultant and designer. We have a show and conference in Las Vegas June 1-9, and I have to attend. I will retire again in 1981 and should be available for our 50th. We hate to miss this, and hope to get together with the Rogowskis before June. All is well."

This is the time to catch up on some of the Alumni Fund notes that have accumulated. One from **Russell Hastings** shows that he is still following the work he has been doing for the past few years. He says, "Having recently spent two weeks in Europe at meetings of the International Standards Organization on the subject of standardization of unit-load and transport package size for the purpose of reducing the cost of transporting goods, I found that any further international communication in terms of inches and pounds can be as counterproductive as the Tower of Babel. If you are not already participating in the voluntary U.transition to the metric system, please get in touch by calling or writing to the American National Metric Council, 1625 Massachusetts Ave., N.W., Washington D.C., for information."

We have another traveler in **Irving Kusnitz** who writes: "I am still active with the chemical division of Beatrice Foods at age 66. After I reached 65 we acquired a new director of engineering, and I am working full time as associate director. My European travels have been cut down (Does Beatrice Foods think jet lag is worse after 65?), but I still cover the Western Hemisphere and look after our plants in Brazil, Venezuela, Nicaragua, Mexico, and Canada, as well as many in the U.S. My best news is that my younger son and family (great wife and two children) now live across the street in Marblehead."

I have items from two "Cape Codders." **Tom LaCava**, whom I see at the M.I.T. Club meetings, retired and is working part time. He has settled in Falmouth. "The winter climate on the Cape we find to be a significant improvement over that usually dished out in Concord, N.H." Our other Caper could almost have opened his window and called his remarks to me. **Bill Main** writes: "I am very busy on town projects, serving as director of the Chatham R.R. Museum, treasurer of the Friends of the Council on Aging in Chatham, and assistant to my wife who serves as director of the Chatham Council on Aging."

To wind up the Alumni Fund notes, here are three that go back some months. **Wally Wise** retired, then was called back to the presidency of the Henry G. Thompson Co. in Branford, Conn. He also reorganized and is now the new president of the New Haven M.I.T. Club. His son and daughter are living in Brussels, and his first grandchild is now one year old. . . . With nary a word about himself, **Joe Bicknell** writes: "I recently received a letter from **Wing Fong Lem**. He left for China after completing his S.M. degree in 1935. We last heard from him in 1939. He is working on building aerodynamics at the Peking Institute of Aeronautics and Astronautics." . . . **Theodore Steinberg** notes: "I just finished serving as president of the American Association of Ophthalmology. Son Joel is a neurosurgeon, daughter Marie an attorney."

Information comes to me in devious and round-about ways. In writing about the reunion "**Stead**" **Wright**, in Wheaton, Ill., comments on their 90 inches of snow and their wondering if they would ever see grass again. He enclosed a clipping, sent to his mother by a friend, from the Needham, Mass., *Chronicle* of March 14, announcing a talk that was to be given by **Bill Baker**, who is still Curator of the Hart Nautical Museum.

As another instance, and just in time for these notes, last night Dr. Leroy Foster, '25, gave me a letter he had received from **Mal Stevens**. Mal explains that he couldn't come to our M.I.T. Club May 10 dinner because on May 14 he and his wife were leaving for Belgium to attend the wedding of their Belgian "daughter" who had stayed with them seven years ago as an A.F.S. exchange student. He says they will be in Belgium just four days and then work their way through Scotland and southwest England. — **Robert M. Franklin**, Secretary, 620 Satucket Rd. (P.O. Box 1147),

Brewster, MA 02631; **George G. Bull**, Assistant Secretary, 4601 N. Park Ave., Apt. 711, Chevy Chase, MD 20015

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I am sorry to have missed getting the notes into the last issue of the *Review*. It was my first miss in nearly nine years. I had a short-lived hiatus just at "deadline" brought on by a combination of exhaustion and stress and it's taken nearly eight weeks to get my energy back and to even think about getting the Class Golf going. My work days are now 8:30 to 4:30, instead of 8:00 to 6:00 plus evenings and weekends. As a result I have much to pass along to you. **William J. Bates**, our '78 Golf Champion, left for Mexico April 25 and here is the letter he wrote before leaving: "Last trip I was consulting with a large steel company. This time I'll go as Assistant Country Director for Mexico and be located in Mexico City. I'll be working for the International Executive Service Corps (an organization of retired executives). They are the people that got me the last assignment. Last time I was in Mexico for three months. This time it could be as long as three years. I'll miss the M.I.T. Golf — I'd like to get in on the new cup. When I come back to the States I'll be in touch to see if the Class of '35 is still playing. My best to you and I'll drop you a line in a few months when I get settled."

As of a month ago 78 of us had sent our \$15 class dues to Treasurer **Randy Antonsen**, so if you had forgotten, do it now. He is still at 96 Bay State Rd., Boston. These notes benefit from some of the notes Randy received with the dues payments.

Gerhard Feyling wrote, "Birgit and I are doing well and hope again this summer to spend July through September in our cottage on Barters Island, Boothbay, Maine. Here in Florida we continue to operate our citrus groves and cattle farm. Ours is a relatively small operation, but we were proud last year to add 1,500 tons of fruit and 50 head of cattle to our nation's food basket. This fall it will be ten years since I 'retired.' After spending 35 years 'behind desks,' this has been a wonderful and rewarding outdoor life, highly recommendable to anyone similarly inclined." . . . From **Les Brooks**, "I object. I was planning to use this \$15 to live on for an hour or two when I retire later this year. I'm sorry to say I don't plan to attend (reunion) next year. I expect to be too busy trying to get settled somewhere where it is warmer. I hope things are going well. Hang on until '85, see you then." . . . **Fred Lincoln** reports he thinks about retiring (don't we all) but still enjoys his work so is going to hang on for at least another year. . . . **Ted Pomeroy** wrote from Cooperstown, N.Y., "We just returned home from spending a few days in Dalton, Mass., with my sister Betty while she had a very successful cataract operation. All of us farmers up here are checking our seeds and garden tools and tractors in anticipation of spring."

The National Academy of Engineering has announced the election to membership of **Bernard Ben Berger** who is currently a Professor of Civil Engineering at the University of Massachusetts in Amherst and was rewarded for his "contributions to solution of complex water-resource problems."

Charlie Piper wrote a long letter which I shall include in the next notes, but I did want to quote a couple of lines from him before I added eight more names to the deceased members of our class. "The number of classmates falling before the grim reaper is getting a little scary. I thought the life expectancy was about 70-75, but our class is disappearing faster than that it seems."

I am sorry to list the following death notices I have received: **William F. Newkirk**, Baltimore, on August 11, 1978; **Douglas F. Illian**, Oak Park, Ill., on September 18, 1978; **E. Leslie Huse**, Morris Plains, N.J., on October 25, 1978; **Ewing T. Sperry**, Irvington, N.J., on November 29, 1978; **Irving L. Newman**, Andover, Mass., on January 19, 1979; **Henry S. Bromley, Jr.**, Conshohocken, Penn., on January 30, 1979; **William W. Seary, Jr.**,

Radnor, Penn., on February 15, 1979; and **Milton K. McLeod**, Hancock, N.H., on February 18, 1979. — **Allan Q. Mowatt**, Secretary, 61 Beaumont Ave., Newtonville, MA 02160

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A note from class President, **Tonny Hittl**, brought the sad news that his wife Marian died unexpectedly in early March. She had been quite ill nearly two years ago but seemed to be recovering slowly. The Hittls had moved into more manageable quarters in Pleasantville, N.Y. (72-2 Foxwood Drive, 10570). To Tony, his daughter and son go deepest sympathy from all who know them. . . . **Albert Emerson** died on November 10, 1978. He lived in Haverill, Mass. I have no further details.

These notes will be read by you long after Alumni Day but I hope that I will have seen many of you before these notes are published. However, here are a few items from the mail bag. **Paul Robbins**, as President of the National Society of Professional Engineers, addressed the Providence Engineering Society's 60th Annual Banquet last February. Paul was Executive Director of the N.S.P.E. for many years, retiring a year ago. . . . **George Ray** notes that he is Vice President of the Mundelein (Illinois) Savings and Loan along with his gift to the Alumni Fund. We appreciate the gift and would also appreciate more detailed news! . . . Ditto from **George Grant** between classes in Monterey, Calif. . . . **Matthew Hayes** writes: "I retired July 1, 1978 and am enjoying photography and bird watching. I manage to keep in touch with M.I.T. through the *Technology Review* and the Educational Council in Buffalo, of which I have been an active member since March 1953." He was with Westinghouse in Buffalo.

Your Secretary is on the same old treadmill but she is still enjoying it and hopes to see as many of you as possible on Saturday, October 27. — **Alice H. Kimball**, Secretary, P.O. Box 31, West Hartford, CT 06091

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Charles W. Gadd of Orchard Lake, Mich., retired in 1976 from the Research Laboratories of General Motors Corp. after 39 years. He was a supervisor of vibration and strength of materials, participating in a great variety of new corporate products over the first half of his career; for the last 20 years he specialized in biomechanics and automotive crash protection. He published 30 papers in engineering and medical journals. Football helmet manufacturers are using his head injury hazard index developed for automotive usage to test and qualify their helmets, and Chuck has recently built a supplementary device for testing helmets. Violin-making is his chief hobby, combining a life-long interest in craftsmanship with an opportunity to apply a little of his technical background in vibration, acoustics, and electronic testing to a new field. One of his instruments took first place overall in a competition in Phoenix last fall amongst 88 violins entered. In addition one of his violins was played in the Detroit Symphony Orchestra during most of the 1977 summer season on loan to a violinist. "Chuck" sold their cruising sailboat, "Southern Gal," after 12 years of racing and cruising and now has a 20-foot day sailer. Chuck and Frances keep busy in the winter with the sport of curling, skiing, and a wide range of outdoor activities with the American Youth Hostels Organization; for 12 years he was on their national board. Last year he visited relatives in Ottawa, Montreal, and the Gaspé and also visited Nova Scotia and the Acadia National Park.

Karl Goodwin is chairman of the New Bedford Five Cent Savings Bank and is also vice president of the local 450-bed hospital. He is looking forward to "retirement" in the spring of 1981. His wife, Caroline, is interested in arts and crafts, a day nursery, and a visiting nurse association. Debby, their only child, is married and has two children, lives in London where her husband works. Karl and Caroline make periodic trips to London and Bermuda. Karl reports he is still

hacking at golf balls, "though the courses get longer and the hills steeper." . . . **Martin Garrett** retired as an executive with Pan American Airways operations at Miami International Airport. His wife's main interest is writing, and their one daughter, Josephine, is married. . . . **William B. Burnet** has retired due to an incapacitating accident but continues to live in his condominium in Bloomington, Minn. He has four children and seven grandchildren. One unmarried daughter is a business executive in San Francisco with Potlatch Paper Co. One son built up the third largest real estate operation in Minneapolis-St. Paul in five years.

Lester Klashman, your assistant secretary, retired in 1972 from the U.S. Environmental Protection Agency with 33 years of government service. After his wife's death in 1971, Les married his first cousin and life-long friend Pearl Kotzen Lodgen in July, 1973. They are living in her converted coach house in Malden, Mass. His one daughter, Martha (divorced), is living with her three children in Peabody, Mass. Pearl has two daughters and one four-year-old granddaughter. Les had open-heart surgery in June, 1977, and received a new "porcine" mitral valve and two arterial by-passes. Before that operation he was unable to walk up one flight of stairs without great effort; on a recent six-week trip to Torremolinos and Malbraca, Spain, he had no difficulty walking five to six miles a day. If any of you reading this have the misfortune to need open-heart surgery, do write or call Les for some first-hand information.

It is with deep regret that I report the death of **John B. Corbett**, of Falls Church, Va. — **Lester Klashman**, Assistant Secretary, 198 Maple St., Malden, MA 02148; **Robert H. Thorson**, Secretary, 506 Riverside Ave., Medford, MA 02155

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Conover Fitch writes that he is a vice president and director of Perry, Dean, Stahl & Rogers, architects in Boston. He is also a trustee of the Society for the Preservation of New England Antiquities and of Boston Home, Inc. . . . **Dick Muther** is giving away the underlying concepts he has developed in 40 years of professional experience by coauthoring a new book, *Systematic Planning of Industrial Facilities*. Buy the book and save his fee.

Word was just received that Dr. **Wilbur J. Wald** passed away last fall. — **A. L. Bruneau, Jr.**, Secretary, 663 Riverview Dr., Chatham, MA 02633

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Alexander Squire was elected to the National Academy of Engineering for his contributions to engineering and project management of the U.S. submarine and breeder reactor programs. Election to the Academy is the highest professional distinction that can be conferred on an engineer and it honors those who have made important contributions to engineering theory and practice or who have demonstrated unusual accomplishments in the pioneering of new and developing fields of technology.

Jim Barton and Mary reported from the Pacific Northwest they will wedge in another round-trip to London before joining classmates at our 40th reunion. . . . **John Alexander** and Betsy reached Papeete in Tahiti in their 38-foot sailboat, and set new course toward New Zealand and Australia. Their crew to Papeete included Janie Alexander and Keith Barton, both of whom ended their crewing duties at Papeete and returned to the U.S. to resume other activities. . . . The **Holden Withingtons** will attend reunion if their schedule at the concurrent Paris International Air Show will permit. . . . **Bill Chance** and **Dick Loesch** may also join the reunion group from the Northwest.

We are saddened by reports of death of three classmates: **Hans F. Schaefer** died on September 27, 1978. There were no details. . . . **William V. Bassett** died on January 16, 1979 at Bethlehem, Penn. After his retirement from Bethlehem Steel Corporation Bill was named Mechanical Engineer

of the Year for 1978 by the American Society of Mechanical Engineers, and he taught part-time at Lafayette College. . . . **Norman Macbeth** died during March 1979 during a visit to Rio de Janeiro. Norman had been Chairman of the Kollmorgen Corporation for the last 22 years. — **Hal Seykota**, Secretary, 1421 Calle Altura, La Jolla, CA 92037

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Class Agent: Phelps A. Walker is our M.I.T. Alumni Fund class agent. His address is 672 Londonberry Rd. N.W., Atlanta, Ga. 30327. He handles the many chores connected with the Fund and the Class of 1940.

Ridin' Out: Lawrence E. DiVenuti, of Revere, Mass., has recently retired from the Transportation Systems Center of the U.S. Dept. of Transportation. He finishes his 29th year of government service as the chief of the facilities branch of the Center, a position he has held since the Center was established in 1970. As so many of his classmates did, Larry served in the U.S. Navy for three and one-half years in World War II.

Legacy: M. Bryce Leggett, associate director of admissions at M.I.T. before his death, was also executive secretary to the trustees of Atoms for Peace Awards, Inc. The *Proceedings of the Atoms for Peace Awards* (a memorial to Henry Ford and Edsel Ford), edited by James R. Killian, Jr., has just been issued by the M.I.T. Press. Bryce had compiled material for the book and was editing the proceedings at the time of his death in the summer of 1977.

Pleased to Say: Mrs. Theodore W. Kheel, the sister of the late **David Sunstein**, has so very kindly sent a note that David's two older sons, Bruce and Drew, were also M.I.T. graduates.

What Now? We have a brief note from **Howard M. Hurst** saying, "Retired from Utah State Division of Health, January 1, 1978, in the position of Associate Director of Health for Environmental Services." And what now, Howard?

Our Sad Duty: We have a note from the M.I.T. Alumni office that they have learned that **John M. Coombs** died July, 1977.

Mini-Reunion Reminder: Bruce Duffett, Class President, has fixed October 12-14 as the time for the first series of Class of 1940 mini-reunions. To be held in Hershey, Penn., with **Norm Kilvans** in charge, the meeting will be the first of several making plans for the grand reunion in June of 1980. Norm's address is 14731 County Line Rd., Chagrin Falls, Ohio 44022. And **John J. Casey, Jr.** will lead a Dallas mini, date set later. John's address is P.O. Box 35001, Dallas, Tex. 75325. — **Frank A. Yett**, Secretary, P.O. Box 562, Long Beach, WN 98631

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The Saga of Leon Crane: John McPhee's best-seller, *Coming Into the Country*, has an incredible story about our classmate Leon Crane. I remember him in our classes and R.O.T.C. as though it were yesterday, but that's not the story. During World War II his B-24 crashed in Alaska — there was one survivor, Leon. He parachuted out of the plane on December 21 in 30-degree-below weather. When he landed he wound himself up in the parachute to keep from freezing. Eight days later, in the second week of March, he found a trapper and his family.

Louise Houssiere Herrington writes, "Continue to do consulting work in geology on a limited basis as well as volunteer work in nursing homes and give volunteer French lessons to promote the furtherance of the French language. I also have been the Parish-wide Memorial Gift Chairman of the Heart Fund for 11 years. My daughter is completing her work on a masters in geology this summer." . . . **Joe Gavin**, President of the Grumman Corp., was awarded the first Long Island Technology Leadership Award from Polytechnic Institute of New York at a dinner on April 20. The Long Island Technology Leadership Award has been established to honor Long Island residents

Coal: The Hazard "Cannot be Overestimated"

Four reasons why physics teachers should be concerned about air pollution, says Joseph J. Devaney, '47, of Los Alamos Scientific Laboratory:

- As teachers, they should be concerned to elucidate good physical principles.
- As philosophers, they should have a general interest in clear thinking.
- As citizens, they should have an interest in good government.
- As living beings, they should have an interest in health and the environment.

On all four criteria, Mr. Devaney tells physics teachers in the September, 1978, issue of *The Physics Teacher*, they and their students should come hard on the side of nuclear power in its controversy with coal as the fuel of the future. "The coal power cycle is orders of magnitude more toxic to humankind than the total fission cycle," he writes.

Most people think the haze seen over much of the U.S. much of the time is in fact natural — "just moisture." That's simply not so, says Mr. Devaney: without particulate nuclei on which to condense, water vapor remains invisible in the air until the humidity reaches the point of supersaturation — about 450 per cent relative humidity. "All the contiguous United States is now needlessly buried in smog," writes Mr. Devaney — and much of it can be blamed on the combustion of coal.

In his analysis, Mr. Devaney stresses the persistence and danger of the smallest particles — 1 micron and less in diameter — contained in the effluent of a coal-burning boiler with even the most efficient scrubber systems in the stack. Given moderate turbulence in the atmosphere, such particles may remain in the air for many hundreds of miles and "in some effective sense over the entire United States." The particle sizes that remain in the air so long are the very ones that are retained most efficiently in the human lung, says Mr. Devaney, and their surface-to-volume ratio, "hence their chemical and biological activity, is very large. . . . The potential and actual hazard to the public cannot be overemphasized," he writes.

"Government efforts to reduce or even control air pollution are greatly hampered by poor physics, bad law, and worse economics," says Mr. Devaney, coming to the policy issues involved. He would replace today's air quality standards with air pollution taxes: "It is best to utilize the strong cost-reduction motivations of industry on the side of reducing pollution rather than against it."

who have made outstanding contributions to science and technology. . . . **Herb Moody** is retiring from Rohm & Haas on April 30 and intends to relax and enjoy life. . . . **Frank Wyle** continues as Chairman of the Board of Wyle Laboratories but relinquished his post as Chief Executive Officer.

Sad News: **Donald Dixon**, Course X, passed away in January. Our condolences to his family.

Your secretary recently contributed a chapter on "Business Strategy Planning" to the Commercial Development Association's book on *Successful Product and Business Development*. In addition I spent two weeks in Japan and led a seminar on business strategy planning. Also, the Outstanding Civilian Service Medal was awarded your secretary by the Department of the Army. Keep sending in the NEWS. — **Henry Avery**, Secretary, U.S.S. Chemicals, 2863 - 600 Grant St., Pittsburgh, PA 15230

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Don Berkey, vice president and general manager of the energy systems and technology division of the General Electric Co. corporate headquarters in Fairfield, Conn., was elected to the National Academy of Engineering. Don's citation highlights his contributions in design, development and program direction of advanced gas turbines and energy systems, including the first successful high-bypass engine. . . . **Wendell Phillips** writes that he has joined Gibbs & Hill, Inc., in New York City as engineering director of transportation and transmission division. . . . **Fran Staszek** has made it — he was elected president of the Boston Edison Co. Previously, Fran had been executive vice president of Boston Edison and is currently a member of M.I.T.'s Visiting Committee for Nuclear Energy.

Bob Rines is still hanging in there with the Loch Ness monster. After somewhat controversial results in his photographic and sonar search for the monster, Bob is now going to use a pair of dolphins fitted with special harnesses to carry cameras or sonar equipment or both. The expedition is being backed by the Academy of Applied Sciences and its president noted that "the Academy isn't quite ready to have the project disclosed publicly." He also said that "we want to make sure it's known the dolphins will be taken care of, that there will be veterinarians along with us, and that adequate steps will be taken to protect the health of the marine mammals."

George Schwartz, our hard-working president, and **Floyd Lyon**, our equally hard-working fund secretary, have started work on the 40th Reunion gift. As you ought to know (if you read these notes) we plan to fund a \$1,000,000 Class of 1942 Chair. We are off to a good start with a \$500,000 matching gift, for which we are all very appreciative, from **John Haas**. Floyd tells me that, thus far, all of the class officers and all of the members of the 40th Reunion gift committee who have been approached have contributed. You each will be hearing from one of the regional vice presidents or from some of Floyd's "workers" in your area. Please — don't stop to think — just give!

Several obits this month: **Dr. Henry A. Hill** of Haverill, Mass., **Dick Fay** of Nahant, Mass., **Bill Horton** of Worthington, Ohio, and Commander **John B. Jorgensen** of South Bristol, Maine. We extend our sincerest sympathy to their families. — **Ken Rosett**, Secretary, 191 Albemarle Rd., White Plains, NY 10605

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Last evening **Andy Corry**, with the able help of his daughter and her fiancé, entertained the 35th reunion committee at his home. **Ruth** and **Norm Sebell** chaired a short meeting to assign **Marguerite** and **Ed Ahlberg**, **Priscilla** and **Bob Breck**, **Anita** and **Les Brindis**, **Jane** and **Louis Demarkles**, **R. J. Horn**, **Melissa** and **Newton Teixeira**, and **Edna** and **Stan Warshaw** last-minute tasks to make the reunion more pleasurable for all. Our column in the next issue will be devoted primarily to reunion news, and a list of attendees.

At the third annual I.E.E.E. Conference on U.S. Technological Policy in Washington, D.C. on May 1-3, **Henry Newton Bowes** and **Newton Teixeira** spent three days together while being educated on the issues affecting and influenced by American engineers. Henry is with Lockheed in Houston. While in Washington, Bowes met with **Henry C. Bourne** (who was just elected to the National Academy of Engineering). Bourne is Director of Physics, Science and Engineering at the National Science Foundation.

Just the week before, **Melissa** and **Newton**, your co-secretaries, had attended an Alumni Council Meeting at which **Frank Press** had spoken on the general subject of innovation and technology policy in the Executive Department.

Alan Conrad Rose, VIII, who went on to a Course XV degree in 1947, has retired from his post as Director of Patents and Licensing at Litton Industries and is now a partner in the law firm of Poms, Smith, Landy, Glenney and Rose in Los Angeles. He wrote that they have just hired "another M.I.T. man": **Gary Speer**, '76.

Last month we wrote about the recent elections to the National Academy of Engineering. There was another distinguished classmate among this illustrious group: **Peter Elias**, XV, now the Webster Professor of Electrical Engineering at M.I.T. was cited "for pioneering in the field of information theory and leadership in electrical engineering education."

We are pleased to include the news that **Andrew F. Corry** has very recently been elected a senior vice president of Boston Edison Co. As one of only three senior vice presidents, Andrew takes on a considerable responsibility; we wish him continued success in his new role.

In March, **Alexander Kusko**, VI, participated in an I.E.E.E. lecture series on power engineering in Boston.

Some time back we asked for a copy of *Technique* for 1944 and 1945, having lost ours. We are pleased to announce that we have been loaned a copy of the '44 *Technique* but we ask again for a copy of the 1945 book. If you have one, or know of one that will not be used, please send, or lend, it to us. They are invaluable for developing the background "feel" for classmates mentioned in the news or in classmate's letters.

And lastly, may we tell you again how much we appreciate the news you take the time to write of yourselves and your families on the flap of the Alumni Fund envelopes. Keep 'em coming! — **Melissa** and **Newton Teixeira**, Co-Secretaries, 92 Webster Park, West Newton, MA 02165

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Dr. Lewis T. Mann, Jr. reports his first child is now in college in Pomona, Calif. Lewis is very active on the local high school "site" committee that, under California law, shapes programs that fit schools to the needs of the students in each specific school. He is very upset with the poor student preparation and attitudes, and parental indifference; for example, in his schools there were no entrants in a recent high school science fair. . . . Sailing remains the important recreation of **John L. Bateman**, still coming about in his venerable 26-foot yawl. John is involved in medical ethics of "death and dying" and is in awe of his five adult offspring. . . . **Ken Davis** has formed a new investment banking firm, Davis, Turner & Co., specializing in corporate development. Their offices are in the Chrysler Building in New York City.

John A. Maynard is now in his 33rd year with Honeywell in Minneapolis. John and wife, Jan, are very active golfers in summer and in curling on ice in winter — John is on the Curling Club board of directors and is chairman of its new facility committee. The Maynards now have five grandchildren, aged two to seven. Besides these busy activities, they have time to vacation at their condominium in West Palm Beach, Fla. . . . **James Craig**, along with **Austin Heath** of Broderick Properties, is expected to do the development work for construction of four terraced buildings for Sargents Wharf, a proposed housing-retail

center in the North End of Boston. Jim previously helped develop Union Wharf into a condominium, one of the fastest-moving developments in the area. Jim also helped to develop Lewis Wharf, which is next door to the proposed Sargents Wharf.

An assistant editor of the *Cleveland Press*, Herb Kamm, visited Israel in April and reported that a ranking aide to Prime Minister Begin said that **Herb Hansell**, in his State Department legal capacity, played an important role in the composition of the Israel-Egypt Peace Treaty. The aide said, "Herb Hansell gave us a firm time in his desire to be sure the treaty was properly worded and he also was the one who came up with the fine points in the language when the precise word or phrase was needed."

A nice note from **Don E. Burke** from St. Petersburg, Fla., suggests the class consider Bermuda in May or June for our 35th Reunion in 1981. Don and Pat spent several days in Bermuda in late March and feel it would be a great place for the Reunion. Don and other alumni from the area were honored to have Professor Walter Rosenblith, Provost of M.I.T., as their guest at a brunch on December 30 for M.I.T. students and prospective M.I.T. students and their parents. The M.I.T.ers were so enthusiastic that Don feels certain that the recent applicants will choose M.I.T.

We are saddened to report the death of **David E. Gates** of Franklin, Vt., on January 22, 1979. Until next time — **Russell K. Dostal**, Secretary, 18837 Palm Cir., Cleveland, OH 44126

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Here's the promised chair update: The following people have completed arrangements for the donation of a chair in The Seventh Row of 10-250: **Harl Aldrich, Tom Bell, Claude and Mary Brenner, Bob Creek, Don Van Greenby, John Karmazin, Dick Knight, Bill McCurdy, Tom McEvoy, Joe Riley, Jack Rizika, Art Schwartz, and Robin Stevenson**. Others are considering; how about you? Remember, you spread it out over five years, and in your tax bracket, it will cost you virtually nothing. They are still saving the rest of that row for us.

John Kellett writes: "I am now working full time on headquarters coordination of Exxon's joint venture power generation project in Hong Kong. This 1700-megawatt, billion-dollar plant to meet Hong Kong's growing electricity demand will primarily burn coal and will start up in stages between 1980 and 1981. . . . **Carol Tucker Seward** is still enjoying life in rural southeastern Massachusetts. Think of her when you dive into an Ocean Spray product."

Hal Raiklen, now living in Long Beach, Calif., was recently appointed to the board of directors for the American National Metric Council. A.N.M.C. is a private organization coordinating the U.S. conversion to S.I. (metrics). On completion of the conversion, it is expected that Long Beach will become Longer Beach, given the ratios involved. Hal is vice president of Research and Engineering for Military Aircraft at the Los Angeles Division of Rockwell International. . . . **Claude Brenner** succeeds Joe F. Moore, '52, as President of the Alumni Association. . . . **Paul Gorman** has been elected group vice president, Engineering and Design, at Chas. T. Main, the Boston-based international engineering firm. He moved into that position from vice president and manager of the Thermal-Nuclear Power Division, joining Main in 1975. He had over 30 years' project management experience on major power projects, according to the *New England Engineering Journal*. (Does that include the water fights, Paul?)

A new research and development facility will be completed this summer at **John Karmazin's** Karmazin Products Corp. in Wyandotte, Mich. They will also have the most modern wind tunnel in the industry, for getting heat transfer information. John is well pleased with the M.I.T. liaison program in which his company is participating. He was in town in May and got together with **Bob Hagopian** and **Ginny Grammer** for dinner.

(Remember the Union Oyster House?) John claims the beaver in his *Karmazin News and Views* paper reminds him of the policeman that gave **Van Greenby** directions a year-and-a-half ago in Haymarket Square. (Could it really be the M.I.T. beaver, John? He isn't wearing a ring. . . .)

Ginny Grammer's (C'est moi) son Charles and his wife Michelle are being graduated from the State University of New York at Geneseo this year, Charles with a double major in communications and theater tech, Michelle with work in English and costume design.

Give **Roy Oberholzer** a call when you are passing through Cedar Rapids, Iowa: 319-395-4272. Roy is at Rockwell International, Plastics Consultant in the Advanced Technology and Engineering Department of the Avionics and Missiles Group.

I regret that I must report the deaths of **Irving C. Bailey**, of West Barnet, Vermont (February 1978), **Dr. Bernard D. Cullity**, of South Bend, Indiana (March 1978), **Carl H. Rooth**, of Dallas, Texas (October 1978), and **Hugh H. Lavery**, of Corinth, New York (December 1978).

Please write, fellers — **Ginny Grammer**, Secretary, 62 Sullivan St., Charlestown, MA 02129

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In April **Ken Brock** joined the New York Hospital/Cornell Medical Center as Director of Capital and Special Projects. It's a big job by any definition; the hospitals are seeking \$275,000,000 of capital, and Ken's responsibility is to achieve their goals. He is looking forward to this new opportunity with great excitement.

Anne and Ken live near the Tappan Zee Bridge, so anyone going north-south, or vice versa, is welcome to stop and enjoy their wonderful hospitality. Their son Charlie is a freshman at M.I.T., and their daughter Lee is now shopping around (she's a high school junior) for her collegiate locus. Anne and Ken are counting the days until they can open their summer place in Truro on Cape Cod.

Ken recently had the delightful pleasure of having dinner with Barbara and **Bill Cummings** in Saginaw, where Bill runs one of G.M.'s principal power steering plants. After dinner Bill introduced Ken to his stable of antique cars (four) — a spectacular sight. It seems that Bill has garage space the size of a home, but one doesn't leave such gems exposed to northern Michigan winters.

Carl H. Lovejoy, '20, recently wrote from Boynton Beach, Fla. Carl has a '48 beer stein, and he wanted to say hello to our class. . . . **Graham Sterling**, president of our class, visited **Georges R. Dube** in Paris during a recent business trip. Georges has lived for many years in France where he is now a senior mathematician with Thompson CSF, a large electronics company based in Paris. He is now in the pleasant position of being able to work only on projects he really likes and to pass along the others to junior members of the staff.

Georges became a French citizen in 1978 and is now engaged to be married to Michel Perrone, also an accomplished mathematician. They have purchased land in a suburb of Paris and are negotiating with the architect who will supervise the design and building of their home. Michel is manager of a micro-programming section, and her big project is a computer-aided whole body tomography system. She visits the U.S. fairly frequently. Analogic Corp. is one of her key contacts, and she knows the president — our classmate, **Bernie Gordon**. Graham suggests that classmates who know Georges drop him a line; his address is 86 Avenue Gastone Boissier, 78220, Viroflay, France. Graham encourages others to look up class members while traveling and re-establish or reinforce their active affiliations with the Institute.

Dick Harris, president of Curtis and Marble, Inc., a privately held textile machinery firm in Worcester, was recently quoted in a financial column of the *Boston Herald American*. He describes how changes in the valuation of the dollar have caused the need to increase U.S. exports.

Kenneth Olsen: "Profit," Not "Growth," is the Game to Play

When Babson College established an Academy of Distinguished Entrepreneurs last year, Kenneth H. Olsen, '50, was chosen among its charter members. Later, the *New York Times* asked Mr. Olsen about entrepreneurship and his view of the success of Digital Equipment Corp., which Mr. Olsen founded in 1957 (January 14, 1979).

Some "very unusual" ideas went into the company's success, Mr. Olsen replied:

— No government funding for D.E.C.'s research. "We wanted to use our own money to develop our own proprietary products because of the disciplines to be learned," Mr. Olsen explained.

— Make a profit. What's so strange about that? "At the time 'profit' was considered a bad word," wrote Mr. Olsen. "All you had to do was grow." D.E.C.'s goal was to show a profit after one year, and it did so.

— No emphasis on growth. People looked askance at this, too, and it's one of the ideas that didn't stick. But the idea of small units and limited growth is still viable at D.E.C., wrote Mr. Olsen.

"We have organized Digital into a number of parts, each having a feeling of autonomy, entrepreneurship, and responsibility to its customers. We think this has worked well. . . . In fact, this feeling of entrepreneurship has been instilled so thoroughly that my role for the last several years has largely been to limit the growth of these various parts of the organization to insure that our total corporate plan is realistic and conservative."



Paul E. Gray, Chancellor, speaking to members of the Class of 1950 and to undergraduates holding Class of 1950 Scholarships in the Bush Room at lunch on March 21. Representatives of the class included Professor Robert W. Mann (left), President,

and Harry G. Foden, '50 (at Dr. Gray's right) of Winchester, Mass. It was the first such meeting of representatives of the class with the scholarship holders since the scholarship fund was established as a result of the class' 25th reunion gift in 1975.

Last month I reported that **Norman L. Seltzer** died in February. His wife Dorothy asked about establishing a memorial fund at M.I.T. On March 29 at a meeting of reunion and class officers we agreed with the Alumni Association's proposal to create an Alumni Fund memorial program. Contributions to the memorial fund will be transferred to the Sloan School for use as a book fund in the Sloan library.

Norman was a member of our class's Reunion Committee for several reunions. I have written letters to the 227 classmates who attended one or more of our reunions and asked them to consider making an additional special gift to the Alumni Fund in memory of Norman. As in any designated gift to M.I.T., the gift would be to the Alumni Fund and the donor would write on his check what amount he wanted credited to the Norman L. Seltzer memorial fund.

George Bamber of Seattle died as a result of a heart attack last November. On behalf of the class extend our sympathy to his widow, Beverly Bamber. — **S. Martin Billett**, Secretary, 16 Greenwood Ave., Barrington, RI 02806

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Several promotions to report this month. At United Technologies Corp. in West Palm Beach, **Bill Missimer** has been named to the new post of Executive Vice President. . . . **Andy Kariotis** is now Chief Executive Officer of Alpha Industries, Inc., in addition to being President and Chief Operating Officer, and at General Dynamics Electric Boat Division, **Dave Bourne** has been promoted to Principal Engineer. . . . **Dave Dennen** continues to work at Eli Lilly and Company as Director of Antibiotic Technical Services. Dave was recently promoted to Colonel in the Indiana National Guard and appointed Commandant, Indiana Military Academy.

Allen Feinberg has been a practicing architect for 17 years. He now has his own business in

Forest Hills, N.Y. His daughter Audry has just started N.Y.U. Law School, after graduating from Wellesley. Son Howard entered his junior year this past fall as a pre-med student in the honors program at the University of Delaware. Beverly is finishing high school and hopes to attend M.I.T. as a chemistry major.

Patricia and **John Goncz** have returned to the mainland after eight years down under in Australia. . . . Carol and **Ronald Kurtz** have been living in New Jersey for the past 16 years. Ron runs a company that makes tungsten and tungsten alloys. They have recently begun a new product line — darts and dart boards. They are having a lot of fun, and this is a rapidly growing sport. First the Beatles, and now darts. Can rugby be far behind?

At this writing, interest is mounting on who will be coming the farthest distance for the reunion. Pat and **Bill Eccles** thought they were in the running from Columbia, S. Carolina, as did the Florida contingent of **Dick Morris**, **Art Milites**, and **Alex Dreyfoos**. The California Suite group of **Ron McKay**, **Sam Losh**, **Dave Leslie**, **Art Haines**, **Al Ward**, **Walt Eppler**, **Sam Armour**, **Bob Anslow**, **Matt Baczewski**, **Ted Slosek**, and **Tony Turano** have yelled foul. It looks like it will be one of the non-continental entries however. Lining up for the long-distance race are Yolanda and **Marty Tovar**, Lucis and **Tom Aguerrevere**, and Annabelle and **Cesar Quintini**, all from Venezuela; **Carlos Roggero** from Peru; and **Jean White Fisch** from Montreal. Our geography is not all that good, after 35 years out of elementary school. But our guess is that Ruth and **Tom Bastis** from Hawaii or Gloria and **Pete Butt** from the Philippines will make the long-distance champ.

This issue completes a string of over 18 years of Class of 1954 notes that have never missed an issue. Our classmates should realize what a point of pride it has been for the dedicated, indomitable **Dave Howes** to see that an issue got out, and going after the news to make it happen. **Ed Eigel** was our first secretary, then **Bob Evans**. When Bob went to Japan, he asked Dave "to take it for a

year." Over the 18 years, Dave has been officially replaced several times, but the ball was never picked up, so he took it back again each time. It has been Lou's and my pleasure to have worked with Dave. — **Dave Howes**, Secretary, Box 66, Carlisle, MA 01741; Assistant Secretaries: **Chuck Masison**, 76 Spellman Rd., Westwood, MA 02090; **Lou Mahoney**, 14 Danby Rd., Stoneham, MA 02180

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Greetings! We have a number of notes which have been delayed some months pending your Western reporter's completion of a 45-day trial and a not-so-brief brief. 'Tis now completed and, coupled with my apologies, here is the news:

We are advised that **Robert G. Dettmer**, Vice President of Financial Management and Planning for PepsiCo Inc., has been elected a director of the Pantasote Co., Greenwich, Conn. Bob joined PepsiCo in Purchase, N.Y., in 1973 as President of its North American Van Lines subsidiary. In addition to his course XV degree, he holds a degree from the Harvard Business School.

We also hear that **Sheldon N. Busansky** has been named Vice President and General Manager of Honeywell's Tampa, Fla. operations. Shelly joined Honeywell in 1962 and was previously operations manager of its Electro-Optics Center, in Lexington. After graduation from Tech he received a law degree from Harvard in 1958 and was awarded an honorary Doctor of Science degree by the Lowell Technical Institute in 1974. Obviously a busy guy, Shelly was a member of the Lowell Board of Trustees (1972-75) and served as its Chairman (1974-75), has been Treasurer of the Minuteman Council of Boy Scouts (since 1977), and Vice President of the New England Chapter of the National Security Industry Association (since 1978). Wow!

On the college front we are advised by **Gil Davidson** that his daughter Amy entered M.I.T. as a member of the Class of 1982. Gil also reports that he visited **Shim Frankenthal's** family in Israel last year while touring with his family. Shim is currently a professor of electrical engineering at Tel Aviv University.

Dick Oman's wife, Sue, writes that their oldest daughter graduates from college this year while the youngest is now a college freshman. Dick is currently Director of Fluid Dynamics in the Research Department of Grumman Aerospace. An avid sailor, he has won several racing trophies on Long Island Sound in the Oman's 26-foot boat.

The perennial student, **Dell Lanier Venarde**, is entering the home stretch in the master's program in math education at the University of Delaware. While Dell is thus seeking her teaching license, she has apparently been spending considerable time on a children's novel set in Pompeii and hopes to finish same before our 25th. Does that imply that you are thinking of assigning your royalties as a class gift, Dell?

We were also advised a few months ago that Colonel **Ernest D. Strait** has been awarded the Legion of Merit, one of the nation's highest decorations, for outstanding service as chief of the facilities programming division of the Directorate of Engineering and Services, at U.S.A.F. Headquarters. Colonel Strait now serves as the Assistant Deputy Chief of Staff for engineering and services at the Headquarters, U.S. Air Forces, in Europe. After graduating in architecture with our class he earned his master's degree in industrial engineering in 1963 at Stanford and continued, with obvious distinction, in his military career.

A couple of short notes — **Philip L. Molten**, another architecture graduate, writes that he was elected the Vice President of the Belvedere-Tiburum Landmarks Society last year. . . . **Allen H. Wahlberg** writes that he is currently the Controller of the Turner Construction Co. and, in addition, is the President of the Youth Council in his home town, Ho-Ho Kus, N.J.

On a sad note, we are advised that **Earl P. Ford**, course XX, passed away last November.

Last and probably least, your Western reporter,

after migrating from New York for what was ostensibly a one-year stay because of the trial of a lawsuit, has decided to trade the one-hour commute from Westchester County for the smog and expense of Beverly Hills. All this and a daughter who is starting at Swarthmore in the fall. In any event, if you are out this way, please give us a ring. — Co-secretaries: **Marc S. Gross**, 341 S. Bedford Dr., Beverly Hills, CA 90212; and **Allan C. Schell**, 19 Wedgemere Ave., Winchester, MA 01890

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Dave Shefrin is president of the Computer Processing Institute in Hartford and Stratford, Conn., which he reports is the largest data processing training school in the U.S. . . . **Harvey Brownrout** was promoted to assistant general patent counsel at Xerox Corp. and he, his wife Sunny and their three children have moved from Westport, Conn., to Rochester, N.Y. Harvey took his law degree at Harvard, and served in the Army Judge Advocate Corps.

Joe Gaziano is in the financial news as president of Tyco Laboratories, Inc., of Exeter, N.H., which is involved in the acquisition of Armin Corp., a plastics manufacturer. He is also a trustee of Berwick Academy in Maine, where his three children are students. . . . **Axel Rosenblad** is head of his own engineering firm in Princeton, N.J. He and Pat have two boys, who crew the family one-ton racing sailboat. . . . **Jory Schlenger** is staff engineer at Singer-Kearfoot and also has a travel agency with his wife Estelle in Pine Brook, N.J. . . . **Pem Shober** has somehow applied his mechanical engineering skill to the trading of interest rate futures and commodities, through his own firm on the Chicago Board of Trade.

Tom Cleaver is on the economics faculty at Villanova while also a full-time law student there. **Richard Jacobs**, a principal at A.T. Kearney in Chicago, recently gave a speech in Paris on his specialty of computer applications. . . . **Jay Silverston** of Lexington, Mass., is either very timely, or else is following a crowd, by recently starting a new consulting firm in energy conservation. . . . **James Allen III** was promoted to Chief Structural Engineer at Stone and Webster in Boston. He and Ginny live in Weston with their four children. — Co-secretaries: **Bruce Budehoff**, 7100 Lanham Ln., Edina, MN 55435; **Warren G. Briggs**, 33 Bancroft Rd., Wellesley Hills, MA 02181 (617) 235-7436

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The backs of Fund envelopes note that **Donald Mott** has left G.E. after sixteen years and is now with Syracuse Research Corp. . . . **Robert Broder** is project director for Latin America for the Cambridge architectural firm of Brown, Daltas and Associates. . . . **Neil Bernstein** is now group vice president with Valtec Corp. in West Boylston, Mass. . . . **Paul Todd**, on leave from his position as professor of biophysics at Penn State, is currently visiting professor of medical physics at U.C. Berkeley. . . . **Walt Humann** is now the chief executive officer of Hunt Investment Corp. and chief operating officer of Hunt Oil Co. — both firms are engaged in oil, gas, and mineral exploration, real estate, and agribusiness. . . . **Neil Harper's** consulting organization, Harper and Shumann, Inc., enters a new building in Cambridge, and begins its seventh year in providing computer-based financial management services for architects and engineers.

Press releases and newspaper clippings: **Roger Travis** has been appointed to the 17-member U.S. Metric Board, created by a 1975 act of Congress to coordinate the voluntary conversion to the metric system. Roger is currently president of Roger E. Travis Associates and will represent small businesses on the metric board. . . . **Jack Fischer**, treasurer, chief financial officer, and a director of Walbar, Inc., in Peabody, Mass., was recently elected a director of Old Colony Bank and Trust of Essex County, a subsidiary of First



"Temptation Under Glass" at the Roger Reiss' Family Store

When Roger Reiss, '55, finishes work at Stone and Webster Engineering Corp. every afternoon, it's only a short stroll through Boston to his second career as Judith Carole Reiss' helper at Judith Carole Curio. It's a family enterprise: Roger designed the store's interior fixtures, Judith moved out of the art world to be a retailer, and son Russel Reiss, 22, is the official manager of the street-level corner in the South Market Arcade in the shadow of Faneuil Hall.

Roger, who turns retailer on nights and

These necklaces are among the many unique antique and curio items from all over the world available at Judith Carole Curio in the South Market Arcade adjacent to Faneuil Hall in Boston.

week-ends, designed the store's big brass key rings — one with a snap hook to fasten onto belt loops, a patented karate design which doubles as a self-defense tool, and others. The store also features gold jewelry — stick-pins, necklaces, unique charms, chains and rings — and antique and curio items from all over. One special attraction is Burmese jade which comes in a variety of colors — red, black, yellow, lavender — and deepens in hue when worn. "... A very easy, unintimidating atmosphere which soon sweeps you into its magic," said *New England Retailer* after visiting the store nearly a year ago. "Temptation under glass..."

Carbone: Engineer/Lawyer Takes Over Massachusetts' Metropolitan Management

When John F. Haggerty resigned under pressure from his new job as Metropolitan District Commissioner in Massachusetts in March, **Guy A. Carbone**, '57, decided it was time to act: he sent his resume to Massachusetts' Governor Edward J. King.

Two months later he was sworn into the job. "I know you won't believe this," he told Lonnie Isabel of the *Boston Globe*, "but I sent in a resume, got called in for an interview and was hired. No one approached me."

Mr. Carbone had two things going for him:

— Government experience. He's a selectman and school committee member in Watertown, Mass., and he was chief engineer for Massachusetts' Government Center Commission for ten years beginning in 1966. He's also had a bit of political experience: capitalizing on his Suffolk University law degree, Mr. Carbone ran



Guy Carbone, '57

— unsuccessfully — for district attorney of Middlesex County, Massachusetts, last fall.

— Engineering experience. Though he's been a practicing lawyer for the past several years, Mr. Carbone hasn't forgotten the engineering he learned at M.I.T. and while working in his father's construction firm (no longer in business). "I think being an engineer gives me an advantage on this job," he told Ms. Isabel, "because a major portion of what the M.D.C. does is construction. . . . I grew up with concrete dust in my pabulum," he said.

Engineering Computers: Don't Forget the "Mid-Life Kicker"

The automobile is a classic example of market pull: cars grew larger and more comfortable, tail fins more prominent, upholstery deeper, engines bigger because people wanted to be more comfortable, to move more quickly, and to expose their taste and prosperity to their friends.

Not so computers: "The history of the computer industry is almost solely one of technology push," writes C. Gordon Bell, '56, J. Craig Mudge, and John E. McNamara, '64, of Digital Equipment Corp. in a new book on *Computer Engineering* (Bedford, Mass.: Digital Press, 1978, \$19.95).

But behind that statement are a lot of variables which do not in fact arise in technology. "It is too simplistic to think that computer design should be a well-defined activity in which mathematical programming can be employed to obtain optimum solutions." The cost is "multivariable," the primary measure — performance — is not well understood, the objective that relates cost and performance is not understood, "objectives are not as objective as they look," and "there is a dynamic aspect (because the technology changes rapidly) which is hard to quantify.

"Computer engineering," write the authors, "is like other engineering: . . . engineers first turn to science for answers and help, then to mathematics for models and intuition, and finally to the seat of their pants."

Computer Engineering is described as "a Digital Equipment Corp. view of hardware systems design" (Mr. Bell is vice president — engineering, Mr. Mudge is consulting engineer, and Mr. McNamara is principal engineer in research and development — all at D.E.C.). But before the authors reach their technical descriptions of D.E.C. product developments, they provide in the early chapters a good deal of general wisdom about engineering and production arising in D.E.C.'s experience.

— Engineering is the major determinant of computer cost, simply by the way the product is designed — number of parts, ease of assembly, etc.

— "Learning curves" and "forgetting curves" are crucially important in managing manufacturing efficiency. "Building up the learning curve quickly by making many units before the design is mature is risky, but it has a high payoff when considering the apparent cost and/or delay. . . . Making major changes in the design of a product or the location of its manufacture starts a new learning curve and serves to stretch the production time out; and the increased costs associated therewith put false pressure on engineering to design new products."

— New technology materials are the most promising source of cost improvement for computers.

— "By enhancing an existing product (the 'mid-life kicker'), one can improve the cost/performance metric of a given product. This is non-trivial, and for certain products must be inherent (i.e., designed in)."

National Boston Corp.

We need more notes, so write! — **Phil Richardson**, 180 Riverside Dr., NY 10024; **John Amrein**, 770 Greenwood Ave., Glencoe, IL 60022; **Adul Pinsuvana**, A.S.E.A.N. Secretariat, 6 Jalan Taman Pejambon, Jakarta, Indonesia; **Bob Muh**, 907 Chantilly Rd., Los Angeles, CA 90024; **Allan Bufferd**, 8 Whitney Rd., Newtonville, MA 02160

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Robert A. Morris has been named vice president and general manager of the Arvey Paper and Supplies Centers Division, Chicago. . . . **Les Evenchick** has joined American Totalizator Systems as a project leader working on wagering systems — spent a year in Bavaria and six months in Argentina. . . . **Dan Thornhill** is still working for SeffTech in Waltham consulting in computer systems — spent three months in Japan teaching structured analysis methods. . . . **Dr. George E. Ioup** is presently associate professor of physics, University of New Orleans. **Dan Smythe** has been at Lincoln Laboratory since 1971, where he has worked on integrated circuit mask fabrication, SAW devices and MOS integrated circuits. . . . **Robert S. Silver** has been elected to membership of the National Academy of Engineering. . . . **Donald Dible**, author of "Up Your Own Organization," was one of ten experts who conducted a seminar at Madison Square Garden early March on preparation necessary before selling an idea, packaging it, and approaching the prospect.

I would like very much a volunteer to take over the position of Class Secretary, as I've been doing it now for 17 years. You might enjoy it — **Gerald L. Katell**, Secretary, 7 Silverbit Ln., Rolling Hills Estates, CA 90274

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You all probably noticed that we skipped a column (only one in five years) back in March. It wasn't that I didn't write one. Oh, I was late as usual, mailing the input on February 12 when it had been due February 4. Then, about three weeks later, I received a letter from the *Review* indicating my February (postmarked!) input had arrived on February 26, too late for the issue. So I thought I'd write a double column for the next month. Wrong again. The deadline notice reached me ten days after the deadline! Naturally, the postmark indicated a three-week mail route between Cambridge, Mass., and Potomac, Md. All I can say is that there must have been some gremlins in the U.S. postal service thwarting the correspondence between *Technology Review* and yours truly during February and March.

Marlene and I have had some hectic but enjoyable months. We recently (April) completed a business/pleasure trip to London, Paris, and Toulouse (France). The business parts were in London and Toulouse, related to an engineering conference on the ATLAS test language. The stopover in Paris was as much due to lack of London-Toulouse flights as anything else, but I can't say we're sorry for it. London was consist-

ently cold, overcast, and drizzly, a "drismal" climatic environment — nonetheless, a delightful place. There was plentiful theater (we saw three shows in four days) with great ticket availability and reasonable prices (compared to New York or Washington, D.C.); a fantastic museum of ancient civilizations and their artifacts; a most interesting Tower of London, with its special lower vault room containing the magnificent Crown Jewels; friendly people; a neat subway system (tube); and probably the best soups we have ever tasted. Also, London has some fine shops on Oxford and Bond streets with good values on sweaters and the like. Finally, we traipsed all around Buckingham Palace following the changing of the various guards one Saturday morning.

Paris provided some sunshine, and all I can say about the Champs Elysees and the Place de l'Etoile (Arc de Triomphe) is that they are breathtaking. Contrary to what we had been told to expect, we found the people in Paris (including the non-English-speaking cab drivers) to be friendly and helpful (despite our feeble attempts at their tongue), and we found the prices of things to be generally reasonable for a metropolis such as Paris. Prior to our trip, we had a nice visit with Ellen and **Gary Walpert** and family. Gary was in the area on business, and six of us (Marilyn and Don Goldman, '65, included) spent a nice evening together at one of our favorite local restaurants.

From press releases: **Mark Radwin** has been appointed principal scientist of Tymnet, Inc., operator of the nation's largest public packet communications network. His primary responsibilities include long-range technical and network operations planning, complex technical problem solving and participation as Tymnet's representative in communication industry forums and functions. Mark has been manager of operations with Tymnet, Inc., since 1977. Prior to joining Tymnet, he was staff scientist with Lockheed Corp.'s Palo Alto research laboratories for ten years.

George C. Ebner is supervisor of the C.C.I.S. (Common Channel Interoffice Signaling, a signaling system for the stored program controlled network) Engineering and Current Studies group at Bell Labs in Holmdel, N.J. This group is responsible for systems engineering for the C.C.I.S. network. Since joining Bell Labs in 1965, George has worked on various exploratory development projects concerning switching processors and C.C.I.S. terminals.

Klaus Kubiershky was honored last November for his service as a North Reading selectman, at a "roast" and testimonial dinner. Klaus began his political career as a homeowner determined to have a voice in his town. Initially, he was elected a commissioner on the Department of Public Works. Over the next ten years, he progressed to town moderator and then selectman. Belated congratulations, Klaus!

Onward to our alumni fund envelopes (keep up the good work and keep those FILLED alumni fund envelopes coming): **Mark Alpert** is once again at the University of Texas after a visiting professorship at the University of Pittsburgh last year. His wife, Judy, is completing her Ph.D. dissertation in music education at the University of Texas. . . . Congrats to **Pete Angevine**. He is now president of the D-O Credit Union. Pete says it's a good use of his "free time," even though he was elected while out of town!

Fran and **Mark Barron** have announced the birth of their first child — David Michael, born April 14, 1978. Mark is employed by Raytheon Missile Systems Division in Bedford, Mass. . . . Another classmate is at the 'tute. **Dr. Leonard Buckle** was promoted to associate professor. . . . **Gale and Edward Casper** and their two children are living in Huntington, Conn. Ed is section head of commercial products at Vick Research. . . . **Thomas Cheek** has been named vice president of engineering for Imlac Corp. Tom, his wife Susan, and their two boys are now settled into their new home in Lexington, Mass.

Last year, **Tom Daniel** received his Ph.D. in physical oceanography from the University of Hawaii. He is now working on O.T.E.C. for Lockheed Missiles and Space Co., Ocean Systems Research and Development Division, Sunnyvale,

Calif. ... **Steve Glassman** has become a partner in the New York law firm of Kaye, Schaffer, Fierman, Hays and Handler where he specializes in corporate, securities and anti-trust litigation. He is still single, and can't wait till our 15th!

Stanley Hallet has become a very busy classmate. He just formed an architectural partnership of Hallet, Hermanson, and Associates. Also, he's been promoted to professor of architecture at the University of Utah. Stan and his wife built a new home and adopted a four-year-old Korean son named Song Soo. Hats off to you! ... One of our classmates has discovered that there is a strong correlation between numbers of cans of beer consumed and numbers of salmon caught. This great discovery was made in Alaska last summer on **Joe Kasper's** vacation. Joe is manager of navigation systems at T.A.S.C. in Reading, Mass. He is also serving as an educational counselor, marketing M.I.T. to local high school students. While Joe's two daughters enjoy school in Andover, Mass., his wife Pat is semi-seriously crafting paper mache dragons, pottery, and pen and ink sketches.

Presently living in Burlington, Vt., with his wife Barbara and his two daughters is **Robert H. Lenox**. Bob is associate professor of psychiatry at the University of Vermont, College of Medicine, and also the director of the neuroscience research unit. ... **Ann Sarney Loomis** has spent the last six months at Fort Huachuca, Ariz., where it's usually warm and sunny. She writes that in honor of their visit the first major snowfall in 40 years occurred! ... Another classmate has moved to the far west, or "California here we come!" The **John Ludutsky** family has moved to Orange County in southern California where he is director of marketing for Edwards Pacemaker, a division of American Hospital Supply Corp. The company's main business area is cardiac pacemakers.

Dr. **Allan Press** and his new bride, the former Lynn Osterkamp, are both at the University of Kansas in Lawrence, Kansas. Allan is associate professor in the School of Social Welfare, and Lynn is finishing her doctoral studies in speech communications and human relations. ... **Lawrence Rabiner** is co-author of a new book, *Digital Processing of Speech Signals*, published by Prentice-Hall. Larry is supervisor in the acoustics research department at Bell Laboratories. ... **Maury Shulman** has just finished a three-month post-graduate course at I.B.M.'s Systems Research Institute in New York City. He is now back at work in Philadelphia as a systems engineer in the large system area.

Had enough for one month? I certainly have. Let me take this opportunity to tell you all it has been a privilege and fun to have been your class secretary these past five years. — **Steve Schlosser**, Secretary, 11129 Deborah Dr., Potomac, MD 20854

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Margaret MacVicar, Associate Professor of Physics at the Institute, spent the winter quarter as the Chancellor's Distinguished Visiting Professor at U.C. Berkeley. **Michael Hester** is still with Lockheed in Burbank, where he has been since graduation. Mike manages a scientific computer systems group in support of flight testing; he remarried two years ago and reports himself as deliriously happy. **John Woods** is still at R.P.I., now as Associate Professor in the Electrical and Systems Engineering Department. **Michael Weiss** sold his old house and moved to a new condominium, "the lazy man's way to live." As you have probably read elsewhere, '65-er **Jim Hester** is the new Executive Vice President of the Alumni Association, succeeding Jim Champy. Last but not least, Pam and I have become proud adoptive parents of our second son.

The cupboard is bare, folks. Drop your old secretary a line while reclining on the beach this summer. Otherwise it will be a fall column of baby and pet stories. — **Edward P. Hoffer**, M.D., Secretary, 12 Upland Road, Wellesley, MA 02181

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Jim Cronburg has successfully defended his architectural thesis at the Boston Architectural Center. His thesis was the renovation of a block of buildings in New York and included developing techniques for the use of video in architecture. ...

Gene and Ruth Goldstein Fax are living in Newton with their three children: Alex (8), Sara (6), and Danny (3). Ruth is a business programmer with ARKAY Computer, Inc., and Gene is deputy manager of the economics and environmental analysis area at Abt Associates. ... Pat and **Jim Gips** live in Medfield. Jim is an associate professor in the computer science department at Boston College. The University of California Press just published *Algorithmic Aesthetics: Computer Models for Criticism and Design in the Arts*, which he co-authored with **George Stiny**.

Bill Ford recently received a four-year appointment as academic computer coordinator in addition to his duties as associate professor of mathematics at the University of the Pacific. His wife Shirley has completed her pharmacology degree at U.O.P. They have two sons, Bret and Bryce. ... **John W. Reynolds** was recently promoted to district engineering manager at New York Telephone. He is responsible for test bureau and operator services planning for New York City. ... **John Patterson** is enrolled in the Navy's Test Pilot School at Patuxent River, Md. He feels it's time consuming, but enjoyable, and probably harder than M.I.T.

Nathan Curland lives in Newton and is a department manager at a Control Data advanced development division in Lexington. He recently made an unsuccessful attempt to become a state representative. ... **Vic Bermudez** received his Ph.D. in physics and physical chemistry from Princeton in 1976. He is presently a research physicist in the Optical Sciences Division of the Naval Research Laboratory, Washington, D.C. His spare time is spent hunting, fishing and hiking in the woods of Virginia, as well as in more urban pursuits in Washington. — **Jim Swanson**, Secretary, 878 Hoffman Terrace, Los Altos, CA 94022

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This month's column completes our eleventh year of writing for the *Review*. Please remember that this is a joint venture and needs your help also. So please drop us a line this summer to say what you've been up to.

In the milestones category, we have two items to report on this month. First, Leslie and **Steven Swibel** have announced the birth of their second child, Laura, on November 30, 1978. Their first child, Debbie, is now three. Last July, Steven became a partner in the Chicago law firm of Soonenschein, Carlin, Nath and Rosenthal. ... In March 1978, **Dave Cahn** married the former Eileen Glenn of Berkeley. Dave adds that he is now with Lawrence Berkeley Lab as principal investigator of the Information Methodology Research Project, doing computer science research.

... Suzanne and **Sherman Hanna** have coauthored a textbook entitled *Housing, Society, and Consumers*. ... **Peter Groot** is still working on TV and computer visual systems for flight simulators. He travels about 13 weeks a year, mostly to Plattsburgh, N.Y., and recalls one trip when it was 75 degrees as he left San Francisco and minus 25 degrees upon arrival in Plattsburgh! ... **Paul Hyman** writes that he completed a fellowship in hematology-oncology in June, 1978 and since July, 1978 has been in private practice in the subspecialties of hematology-oncology in Huntington, N.Y. Paul and Diane have bought a house and are living in Dix Hills, N.Y. ... After working for Mathematica for almost two years, **Bob Roach** has been transferred to Houston where he is in charge of technical services for their new field office. ... From scenic Washington, we have two recent notes from nearby classmates. **Jay Hellman** formed his own real estate development company here in August, 1979 and then worked with the Municipal Planning Office to



Mark Radwin, '64, was recently appointed principal scientist of Tymnet, Inc., operator of the nation's largest public packet communications network. His primary responsibilities include long-range technical and network operations planning, complex technical problem solving and participation as Tymnet's representative in communication industry forums and functions.

eliminate bureaucracy in approving planned unit developments. His first test case, Lafayette Centre, is now under construction. ... **John Niles** resigned from his position with the D.C. city government to do free-lance writing and consulting in the state-local government management field. He is enjoying the change. ... Also leaving government was **Karla Karash** who left office when governors changed in Massachusetts. She's now planning to receive a Ph.D. in civil engineering from the 'Tute this fall.

If you're passing through Peking soon, you're invited to stop in to see **Ken Morse** and George Koo, '62, who have set up shop as Chase Pacific Trade Advisors in Room 1201 of the Peking Hotel. ... Finally, **Roy Shapiro** was recently promoted to associate professor of business administration at Harvard Business School. ... That's all we have for now. We hope that you all have a nice summer — **Gail and Mike Marcus**, Secretaries, 2207 Redfield Dr., Falls Church, VA 22043

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Varied activities involve the class. **Tim Gilmore** is a law student at the University of Washington after two years in Alaska as an environmental engineer. ... **Bruce Lautenschlager** has just graduated with an accounting M.S. from the University of Wisconsin, Milwaukee. ... Visitors to Boston can see **Lawrence Bell's** work as director of Exhibits Research and Planning at the Museum of Science. ... **Herb Stevens** and wife had the right idea — both quit work for a year to travel the world. They'll be spending most of their time hiking and climbing in New Zealand, Nepal, the Alps and

other similar mountainous areas. In more normal times, he practices law and she teaches.

Paula J. Fines is head of Western Electric's Hybrid Integrated Circuit Engineering Dept. Daughter Jennifer is two years old. . . . A fellowship in retinal surgery in Chicago is being pursued by **James Liang**, after which he will be Chief Resident at the University of Illinois Eye and Ear Infirmary. His wife, Jocelyn, is working on a Ph.D. in astronomy at the University of Chicago. . . . **Reid Ashe** sent along a pictorial announcement of his marriage to Lisa Frye in Jackson, Tenn. . . . Attorney at Sullivan and Cromwell in New York is the present position for **Gregory K. Palm** following a remarkable legal education including an MBA/JD at Harvard, law clerk to Judge Friendly (2nd Cir. U.S. Court of Appeals) and law clerk to U.S. Supreme Court Justice Lewis F. Powell.

Tom Derby is vice president and director of marketing for International Energy Conservation Systems which has assembled a network of sixty buildings in many cities and whose energy consumption is controlled by a computer. . . . **Fred Campling** is an Assistant Crown Attorney in Hamilton, Ontario. He prosecutes all levels of criminal misdeeds.

A letter from **Earl Withycombe** filled in some past news — Sierra Tech Associates is now a proprietorship under his registered civil engineer's certification. Then he was elected to public office (the first one so noted in Class of 1970) as a county supervisor and then became chairman of the board in his first term. Earl spends most of his time as a consulting air pollution engineer and with wife and four daughters. . . . The **Robert O. Vegeler** family has moved into their house. Another member is on the way. I have learned a great deal from doing much of the building work myself. — **Robert Vegeler**, Secretary, Kennerk, Dumas, Burke and Bachs, 2120 Ft. Wayne National Bank Bldg., Ft. Wayne, IN 47802

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Dwight Davis has left the government to join Planning Associates, a diversified consulting firm in Merced, Calif., as a business/financial analyst. . . . **Siegfried Mathias** is with Arthur D. Little in Cambridge as an engineering consultant. His hobbies are currently repairing autos — especially engine work — and owning, playing, and repairing pinball machines. . . . **Gus J. Vlahakes** is enjoying a two-year research fellowship at U.C. San Francisco and will return to Mass. General to finish surgical training in 1980. . . . **Don Krasnick** is moving to Philadelphia to be director of product development for Human Design Systems, a manufacturer of intelligent C.R.T. terminals, after working in D.C. for the past five years. Don and Elaine (Simmons '71) have two children: Alan (8 mos.) and Matthew (3½ years). Don reports he worked with **Henry Stern** and Dave Oyer, '73, at T.M.I. Systems Corp.

I am glad that the cold weather is over for another year. Please write. — **Hal Moorman**, Secretary, P.O. Box 1808, Brenham, TX 77833

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We have lots of news this month, mostly from the flip side of alumni fund envelopes. Just as all knowledge can seemingly be packaged as 50-minute classroom lectures, so one year in the life of the average M.I.T. grad can, I suppose, be detailed in six lines on the back of a fund envelope.

Paul Hochfeld writes that he is doing a family practice residency in Charleston, S.C. "living across the street from the Atlantic Ocean with my 1-year-old golden retriever, 'Del Mar,' and hoping to eventually make it to the woods of the Great Northwest." . . . **Daniel Nadler** completed his M.D. at Dartmouth, obtained a master's in epidemiology at Harvard School of Public Health last year and is now a resident in ophthalmology at New England Medical Center. . . . **John Cross** joined Milliken Chemicals last October. . . . **Kevin Trangle** is an intern in medicine at the University of Washington

in Seattle. . . . **Charlie Mann** has just completed a book with James Heller, *Coal and Profitability*, published by McGraw-Hill.

Leonard Pfister got his doctorate in atmospheric science from the University of Washington (Seattle) in mid-1977 and is now a postdoc at N.A.S.A.'s Ames Research Center, near San Francisco. . . . Lt. **Chris Stickler** is the weapons officer on the U.S.S. Francis Scott Key, the first submarine to be armed with the Trident missile. . . . **Robert Tutunjian** is living in Burlington, Mass., and has just started work at the Amicon Corp. in Lexington.

Edward Chapman got his Ph.D. in geophysics from Columbia in January and is now working in the Shell exploration division. . . . **John Krzywicki** will be married on June 23 to Lelon M. Bohne (Wellesley, '75) in Wilmette, Ill. . . . **John L. Miller** is working as a physicist in the laser program at Lawrence Livermore Lab and living in Dublin, Calif. . . . **Conor Reilly** is practicing law in New York for Couderc Brothers and will be going to Hong Kong for a year starting this summer.

Daniel Geer writes that he has been spending time in jail in New Hampshire in connection with the Seabrook affair and editorializes: "Don't you think it's about time to get rid of Rasmussen and nuclear engineering?"

Douglas Mahone reports: "Since graduation I've formed an architectural practice in partnership with professor Edward Allen. We're doing some nice residential projects, most with active or passive solar heating features. I've also worked at M.I.T., developing a program plan for energy and buildings research. I'm living in a neat little brick cottage on a hill in Watertown. Lisa Herchong, '78, and I are still together, although her job with T.E.A., Inc., in Harrisville, N.H., has us commuting a lot.

Jim Roxlo reports that he is enjoying life in New Jersey. He had a successful summer sailing a Finn, although he reports that small lake sailing is a world of difference from the Muddy Charles (river or pub?). . . . **Beverly Klingensmith Roberts** was recently hired as a senior engineer by E.I. duPont de Nemours. She is working at the Savannah River Plant in Aiken, S.C. . . . **Joseph E. Qualitz** of Artisan Industries, Inc. helped co-author *Machines, Language and Computation*.

It's getting married time again! Confirmed bachelor **Riccardo Dicapua** broke the hearts of many women when he said his marital vows in Baranquilla, Colombia, in early April. . . . **Jim Mosora** got married last July, and someone in the pair is a great cook since he has put on 20 pounds. He is having fun with his Radio Shack home computer, and in his spare time he acts as chief of the Data Systems Management Branch for the 1st Aerospace Communications Group out at the headquarters of Strategic Air Command.

That's it for news this month, please write and keep us posted on what you are doing. I occasionally run into **Betty Hutchins** on the tramway (usually late at night when she is returning from her silversmithing class). Spring has sprung here, and with it I have started traveling with work and otherwise to Washington, D.C., Chicago, and Detroit; Dallas is the next scheduled trip. — **Wendy Erb**, Secretary, 531 Main St. North — Apt. 714, Roosevelt Island, New York, NY 10044

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Life finds us all in transit, and your happy correspondent, the weary hero, is transiting from Olde Bosoxville to awl country. See below.

Alice Sproue got her S.M. from the 'tute in 1977 and joined TRW in Redondo Beach; she is now working on a project to build heat exchangers for ocean thermal energy conversion. **Dan Cummings** entered Carnegie-Mellon in January to pursue a Ph.D. in chemical engineering. **David Reed** got his Ph.D. from ol' M.I.T. in computers and is now an assistant professor there, with a child (Colin) and a house in Wellesley — how bourgeois can you get, quoth he? Dave asks if we have all fallen into a black hole, since '73 has seemingly disappeared. Well, Ah'm hyah, anyhow.

John Lange is an associate with the law firm of Andrews Kurth Campbell and Jones in Houston, Texas. More on Texas to follow. . . . **Bruce Zak** is also there, having moved to Carrollton, Texas, after being transferred from Chicago by DEC — or at least his wife was. Bruce himself is in the data processing department of the LFWF management consulting firm. More on Carrollton, Texas to come. . . . **William Hsieh** moved to Memphis to work as a merger and acquisition analyst for Holiday Inns, Inc., a company yours truly keeps alive singlehandedly. **Alan Snyder** just completed his Ph.D. thesis at M.I.T. in computer science. Dr. **Steve Warsof** is still in Washington D.C., as a resident in obstetrics and gynecology. He writes of having become "real middle class," as shown by having bought a condominium, although the Tech Loan Fund has not yet blessed him with a mortgage. **Richard Galik** works with physicists from Pennsylvania, Brown, and Brookhaven on a large-scale neutrino experiment. **Doug Levene** finishes up with news of finishing a year of law school at Michigan — "fun," which he supposes "is enough of a miracle."

Yours egregiously is now a Texan. Th' ol' Tarheel also lives in Carrollton, Texas, courtesy of my company's transfer policy. Bless their hearts though — they have held me for a few interim months at headquarters in Pleasantville, NY. At least my house is bigger than **Tony Scandora's!** — **Robert M. O. Sutton**, Secretary, 2005 Cedarwood, Carrollton, TX 75006

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If this column seems a little choppy that's because some of the news originally meant to appear last time was held over because of space constraints. I'm actually quite pleased that we had so many class notes that they could spill over into another issue — proof that the Class of 1975 has been very faithful of late with their writing. Thanks to all of you who have been in touch.

Michael Lebowitz is currently in grad school at Yale in the Department of Computer Science. He is part of the Yale Artificial Intelligence Project which is trying to develop programs to understand natural language as well as learn more about how the human mind performs this task. . . . **Christine Cowan** received her M.B.A. from Harvard in June, 1978, and moved to New York City where she has begun working for Westvaco, a pulp and paper manufacturer. She is spending her first year in the corporate traffic department, but will move to purchasing sometime this summer. . . . **Robert Gerstmyer** is living in the San Francisco Bay Area and is enjoying it immensely. "The skiing at Tahoe this winter made things even nicer. For diversion and income, I work at Hewlett-Packard on computer communications networks."

Daryl Merrett wrote me a note in which he had this to say, "Following graduation from biology, I spent two years back in my home town of Regina, Saskatchewan, Canada. I worked for a while as a clerk in a bank and did some part-time teaching at the University of Regina. For most of the time, I also worked as a lifeguard at the city's newly opened Olympic-sized swimming pool. Realizing that there was little 'future' in these kinds of jobs, I decided to go back to school. In the fall of 1977, I went to the London School of Economics on a Commonwealth Scholarship. There I took a one-year master's degree in economics. Since October, 1978, I have been working in Ottawa as an economist with the Bank of Canada, Canada's 'federal reserve.'"

I received a bulletin from the Department of the Navy which informed me that **Jeff Schweiger** has been designated a tactical coordinator (TACCO). He received the designation after approximately two years of study and training as a navigator/communicator aboard the P3C 'Orion' antisubmarine warfare (ASW) aircraft. During ASW patrols, the TACCO analyzes data from computer and detection equipment aboard the 'Orion,' which enables him to locate and identify ships and aircraft in the area. If enemy submarines are located, the TACCO directs and controls the movements of his aircraft in tracking and surveil-

lance. Jeff is currently serving with Patrol Squadron 19, based at Moffett Field, Calif., deployed to Adak, Alaska.

Dave Katz writes loads of news about classmates. Dave recently moved to Kansas City where he's working for Burns and McDonnell Engineers, writing environmental impact statements. His firm designs power plants and airports. Dave is also an associate class agent and he's been calling some of our classmates.

He had this to report: **Dave Bufford** is going to business school at Cornell. . . . **Lois and Ricky Campbell** are living in Hartford, Conn., where Rick works for Traveller's Insurance. . . . **Mark Dahl** is living in Annandale, Vir., and is working for the Naval Electric Systems Command in Washington, D.C. . . . **Chris Dippel** is about an hour away from Dave at the University of Kansas working on his Ph.D. in reproductive physiology. . . . **Bruce Fegley** is working on his Ph.D. in geochemistry at M.I.T., and is living in Somerville. . . . **Dan Gantt** is working for Fish and Neave in N.Y.C. after going to Georgetown Law. . . . **Mitch Green** has been working for Skidmore, Owings, and Merrill for one and a half years.

Donald Shobrys married Carol Aronson (B.S. Ch. E., Northwestern, 1977) on August 27, 1977. He received his M.S. from Northwestern in environmental health engineering. He's currently at Johns Hopkins in a Ph.D. program in the Department of Geography and Environmental Engineering. Carol is an applications engineer for E.M.C. Controls which supplies computer process control systems to the chemical industry. Donald is working with operations research applications in the environmental area and is trying to start running again. . . . This March, **Ru-Mei and Lila Kobylak Kung** had their second child, a girl. Lila says, "What a wonderful experience — am staying home — raising children, baking bread, gardening, and sewing. Ru-Mei is a staff scientist at LBL. We just bought a house and are learning a great deal about homes." . . . We have a couple of other classmates that are recent homeowners.

Lt. Martha Donahue Callaway was married to Capt. Michael Callaway (Berkeley, '68) on May 21, 1978. Mike and Martha are both assigned to Hanscom A.F.B. (Bedford, Mass.) and they work in systems acquisition. They bought a house in Billerica, Mass. and are discovering the responsibilities of home ownership. . . . **Tom Durgavich** has been dealing successfully with these responsibilities for a year or so with his new house in Woburn, Mass. His handling of culinary responsibilities, however, leaves something to be desired. Recently, **Sid Haskell** and I went out to see Tom having been promised a home-cooked fish dinner. When we got there, Tom had already thrown in the towel as his sole filets had fallen apart (What do you expect from Purity Supreme?) and the master chef took us out to eat instead at Chubb's Pier in Burlington. We all wished we'd stuck to the sole.

Alex Pankow finished at Sloan and is heading down to Washington, D.C., to work for American Management Systems. . . . **Glen Speckert** got married to his wife Gail (from Urbana) and is working for Lawrence Livermore Labs in California. . . . **Susan Nygard Kronenberger** married Edward J. Kronenberger ('74) on August 30, 1975. Susan moved to Michigan where Ed was employed by Dow Chemical and attended Michigan State from September, 1975 to June 1976. During that year, she drifted away from planetary astronomy to geophysics. She joined the Seismographic Service in July 1976. In October Susan volunteered for a temporary assignment in Houston. Her purpose was to job hunt for a better position which she found with Shell Oil as a geophysicist. Ed and Susan were separated for eight months until Ed obtained his transfer in June, 1977. They purchased their first house in January of 1978. Susan is presently taking night courses part-time at the University of Houston towards a Ph.D. in geophysics. . . . **Woody Pidcock** is working as a systems analyst for B.P. Technical Services, Inc., in Cambridge, Mass. Woody spends his time at an Urban Lutheran Church in Roxbury and lives in Brookline with Carl Sharon, '76.

Tom Higgins is doing missionary work for the Mormon Church in Montreal and southern Quebec. . . . **Roland Janbergs** is working at one of the many Grumman Aerospace facilities on Long Island. . . . **Brian Jaski** is almost done with his M.D. at Harvard and may be going to Barnes Hospital in St. Louis. St. Louis is where **Jack Mosinger** is working in his family's shoe business. . . . **Holli Jones** is working for Polaroid in Norwood. . . . **Karl and Chris Lofgren** are out in Long Beach, Calif. They both work for Rockwell and are trying to make their respective national rowing teams. . . . **Norris Preyer** still enjoys teaching physics at the McCallie School in Chattanooga, Tenn. . . . **Alan Sopolak**, living in Hartford, is working for Roger Anderson and Co. after getting his M.S. in operations research at Berkeley.

After finishing a Ph.D. at CalTech, **Seth Stein** is working as a post-doc at the Stanford Geophysics Department. His area of specialty is plate tectonics. . . . **David Strauss** is working for Terredyne in Boston and just bought a house in Needham. . . . **Roger Edson**, after getting his master's in atmospheric sciences at Colorado State, is a first lieutenant in the air weather services at Offutt A.F.B. in Omaha, Neb. . . . **Ken Chomitz** is living in Laguna Beach and working on an economics Ph.D. at U.C., Davis. Thank you, Dave, for all the info.

Before I end this column I have to correct a mistake from last time. A line was left out of the paragraph listing the guests at the wedding of **Peter and Jackie Blanshan** and Ron 'Bepo' Koppersmith's, '74, wife's name was printed to be Tina. Bepo was there with his wife Diane, and Bruce Schreiber, '74, was there with his wife Tina. I feel terrible about this error, but we secretaries don't get to see the galley proofs, so we don't see the misprints until the magazine comes out. Until next time. — **Jennifer Gordon**, 22 Centre St. No. 9, Cambridge, MA 02139

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We have a veritable bonanza this month! **Martin Brock** writes that he spent a very enjoyable year and a half working for I.B.M. in White Plains, N.Y. He will be returning to M.I.T. this fall as a grad student in the Electrical Engineering and Computer Science Department. This summer he plans to take a six-week trip to Europe. . . . **Greg Malkin** is helping his uncle run a small mechanical contracting company in Cleveland. His responsibilities take in all facets of the business — sales, engineering, project managing, etc. "Calculus is long forgotten." . . . **Frank Ruiz** is living in Harrisburg, Penn., and is working as a development engineer for AMP, Inc. (He left Corning in January of last year.) Referring to his interest in the saxophone, he says "the jazz inside is still flowing."

Ben Szaro is working on his Ph.D. thesis at Johns Hopkins in biophysics. . . . **Rob Shults** is still working for Sweet Associates, and is helping to construct a new silicone process plant for General Electric in Waterford, N.Y. An anecdote: "Last winter, stuck in one of our frequent snowstorms, I asked two passersby to help. One of them turned out to be **Andy Chestnut**, a fellow Bakerite — and now a new neighbor, living three houses down the street. He is working at the G.E. main plant in Schenectady in their financial analyst training program." . . . **Kirk Blunck** worked for one year and then returned to the graduate school of architecture at the University of Oregon. There he held a research position as a graduate teaching fellow. He is now working with Brooks, Borg, and Skiles Architects in Des Moines on downtown redevelopment projects.

Dave Maass is working in the structures and materials group at Sikorsky Aircraft on the development of advanced composite materials for helicopter applications. He's also active in the M.I.T. Club in Fairfield County as program chairman. . . . **Andrew Frechling** succinctly states, "I am designing and building new glass manufacturing equipment, and flying sail-planes at nearby Harris Hill." . . . **Thomas Hirasuna** reports that he has been elected secretary of the Tappan-Zee

section of the American Institute of Chemical Engineers for 1979. The Tappan-Zee section serves Westchester and Rockland Counties of N.Y.

Robert Montante is a development engineer for Ektaprint copier-duplicators for Eastman-Kodak. "I play with computers quite a bit in vaguely work-related ways. I enjoy cross-country skiing in western New York in the winters, but don't have enough vacation in the summer to escape the second-cloudiest city in the U.S. I am turning into the wrong kind of mushroom." . . . **Richard Lopiccolo** writes: "Since I last wrote in September, 1978, I was deployed on U.S.S. Silversides to the Mediterranean. We were at sea most of the time from September, 1978, to March, 1979, when we returned to Norfolk, Va. I was qualified engineering officer of the watch on Silversides' propulsion plant and am now working on my qualifications in submarines. Thus far, it looks like a career. I'm really enjoying it — was promoted to lieutenant junior grade in April, 1979."

I received a remarkable letter from **Lee Gearhart**, in the form of a rewritten "Howard the Duke" comic book. The story line concerns Howard and "The Final Bong." Lee is enjoying working at the Gleason works, maker of fine machine tools, except for a communication problem between himself and the mechanical engineers who dominate the company ("I've begun to feel like an ant in the middle of a beehive.") One other Lee comment, which I think is germane to many of us: "Projects and crises come and go, but paperwork is eternal."

Marilyn Taggi sends news that she married Alan Cisar, '73. They both finished grad school at Iowa State last spring and moved down to Houston to work. Al is employed as a senior chemist for Dow Chemical in Freeport, Tex., and Marilyn is working as a geological engineer for Shell Oil Co. in Houston in the Rocky Mountain Division. "I spent a great portion of the last nine months actually out at the drilling rigs and production facilities in California, Montana, and North Dakota which was quite exciting at times. Now I have a desk job picking development well sites. I spent two months last winter at Shell's training center taking a course with **Susan Smolinski**, and I'm working on the same floor as Bernice Williams, '78. I never cease to be amazed by the number of Brass Rats you see around here!"

Mike Rabkin has been accepted for the Ph.D. program in physiology at Duke, which will take three to four years to complete. Coupled with his M.D. degree, Mike looks forward to finishing in 1983 or 1984. Make wants to give science a good trial rather than simply settle into medicine. Aside from academics, his other interests now encompass cooking — French and Oriental — and dance (jazz, modern and disco).

Your secretary had the pleasure of bumping into **Tom Openshaw** and **Carl Sharon** on the Green Line. Unfortunately, we had all of one stop to talk. Tom is now at S.U.N.Y. Albany medical school. I did not have time to find out what Carl was up to — however, Carl now has a beard. . . . **Mike Sarfatti** dropped by my office while he was passing through Boston. Mike's next stop will be San Francisco, now that he finished his assignment in New Orleans.

Erland van Lidthe de Jeude called to tell me that his movie will be coming out in June in 800 theaters across the U.S. The title is *The Wanderers*. Erland is swinging into full form to become the U.S. heavyweight wrestling representative in the 1980 Olympics. . . . **Lindsay Weaver** is an engineer at Linkabit Corp., San Diego, Calif. He is involved with satellite communications. He married right after getting out of grad school, to Francine Lavin. At the time we spoke, both **Tony Lake** and **Keith Amundsen** had been out to visit him. . . . **Debbie Stein** has bought a home in Saratoga Springs, N.Y., and is to be found working at General Electric in their silicone products department. . . . **George Dimitriou** is a financial analyst at the Third National Bank of Springfield. He married Gail Russell in June 1978. . . . **David Ying** is with Shearson, Hayden, Stone in N.Y.C. in investment banking. **Tom**



James L. Bigidare (left), president of the Class of 1978 presented the class gift to President Jerome B. Weisner in an informal ceremony in Lobby 7 on May 7. The gift, an arrangement of benches and plants to replace the former rug-covered blocks, is the first class gift to M.I.T. in over four years.

About \$850 was raised from class donations, and another \$850 came from a matching grant donated by Challenge/78 of the Alumni Association. An anonymous member of the Class of 1928 donated another \$1,000 in support of the concept of a class gift.

Parham married Pam Whitman, '77, on January 1, 1979.

Doug Nutter is at General Electric as a technical marketing specialist. . . . **Carl Shapiro** is a grad student at the 'Tute in economics. . . . **Steve Balbus** is at Berkeley in theoretical physics. . . . **Holly Horton** is working as a geologist in San Francisco. . . . **Ed De Jong** is in Cambridge working as a programmer/analyst and is possibly self-employed at this point. . . . **Cathy Kiselyak** is still at Yale Law School, and spent part of the year interning with two law firms, one in Chicago, the other in San Francisco. . . . **Paul Fryd** is at Stanford Law School. . . . **Richard Radville** is working at the Architects Collaborative. . . . **Deran Dinjian** has been doing a lot of traveling (including Mexico) and is into real estate brokering.

I'm still spending a lot of time keeping my business going (and it is, in fits and starts). Although the commodity markets have no deadlines, some of the price savings require the utmost attention from me lest we founder. Meanwhile, the silver market beckons. — **Arthur J. Carp**, Secretary, Endymion Commodities, Inc., 131 State St., Suite 616, Boston, MA 02109

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This month's class notes come courtesy of **Jan Krakauer** who was in Boston recently and left this letter. "I've been in touch with some classmates and here is the lowdown:

"**Al Ericson** is putting his degree in architecture to good use as a salesman for Unistress Corp. in Pittsfield, Mass. . . . **Dave Dobos** is wrapping up a one-year stint with the M.I.T. admissions office this spring. He plans to return home to Columbus, Ohio, for the summer where he has a job doing public relations for a country club. . . . **Dan Peaco** is working as a civil engineer in Boston. He has just received a fellowship from Dartmouth, where he plans to finish the M.S. he began at Michigan several years ago.

"**Eric Lindstrom** has been studying oceanography at the University of Washington, Seattle. Eric has apparently been doing some quite interesting stuff. Last summer he went on a work-cruise to do some investigation in the Bermuda Triangle. This summer he'll be on another cruise, this time to study western Pacific oceanography. He's been in on several papers, has completed an M.S., and has gotten married recently. What else can you do? . . . **Doug Feinstein** is working on a Ph.D. in biology at Johns Hopkins. Doug played guitar last summer for a band in Baltimore. . . . **Sarkis Koltoukian** is a mechanical engineer for John Deere, Waterloo, Iowa. He has just bought a house and a second Corvette. Sarkis likes Corvettes. He plans to drive a 'vette around this summer, as usual. If you're in Iowa, that white tornado that blows by you is Sarkis.

"**Tom Fetter**, last I heard, was working for H.P.'s instrument division in Loveland, Colo. He has started heading for the nearby mountains on weekends.

"My decision to go to the University of Wisconsin turned out to be a good one. I completed a M.S. in December, 1978, and enjoyed Madison, a 24-hour party town and a super place to go to school. I'm now an engineer for a small but reputable company which does testing/research on manufacturing materials and conditions. As a low-level engineer I have a good amount of responsibility and a large amount of work, which leave me little time to customize the van I bought recently." — **Douglas J. McLeod**, 11 Silvey Pl., No. 1, Somerville, MA 02143

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It's the last day of classes here, with two weeks of finals to go; but neither rain, sleet, snow, nor finals will stop this class secretary. . . . although some nice weather might (little chance of that in Ann Arbor).

One of our classmates has "made it big" here at

University of Michigan Law School. Big **Al Knauf** stepped up to president of the Law School Student Senate. . . . **Brian Fiedler** writes, "I'm being literally spaced-out at the Department of Astro-Geophysics at the University of Colorado, Boulder, where I'm presently a first-year space cadet studying planetary atmospheres. . . . P.S. I spoke to **Phill Klenn** who is still loyal to his old habit of getting drunk and contemplating large bodies of water from his window. He says San Francisco Bay isn't quite as nice as the Charles River Basin — but it gets the job done. He's at U.C. Berkeley studying Chem. E."

Marianne Unger writes from the University of Illinois Medical School in Chicago to say that she is trying to adjust to the Midwest (I can sympathize). Med school, she says, is not as difficult as it is time-consuming, but starting next year she'll be doing much of her work in hospitals and clinics instead of in classrooms, a welcome change. This summer she plans to be in Chicago, enjoying her free time sunbathing, doing some work, and making up for time lost in the textbooks. Doctor Unger, if you get a chance, I have this nagging pain . . . or maybe Doctor **Ed Michelson** (I use the term "doctor" loosely) could take a look at it. Ed writes from Washington University in St. Louis Medical School, complaining that there is no decent sailing within fifty miles, "Oh, but to be back on the Charles!"

Larry Yablom is working in Albany, Ga., building a brewery for Miller Beer (Larry's a management trainee for the Gilbane Building Co.). Can we expect some free samples at our first reunion? . . . While we're on beverages, **Peter Coffee** has moved down to Baton Rouge, La. Peter spent nine months, working in New Jersey when he decided to pull up stakes and move south. He'll be working for Exxon Chemical as a cost control engineer for a facility soon to be built. He expects to be down there for about two years . . . just long enough to pick up a southern accent.

Howard Katz is studying for his Ph.D. in organic chemistry at U.C.L.A. Howard occupies much of his spare time playing in the U.C.L.A. Symphony. U.C.L.A., he writes, "while high-powered enough, also reflects the Southern Californian penchant for taking things a bit easier than in the Northeast."

Paul Martin is "currently a graduate student at the University of Illinois. In addition to their engineering school, which is the equal of M.I.T.'s, the University has the fifth-ranked music school in the country, and I am taking full advantage of that." . . . **Howard Runge** spent this past summer "working for the Shell Oil Co. where I enjoyed flying around the Gulf of Mexico by helicopter doing a safety inspection of Shell's offshore heliports. The southern climate wasn't for me so now I am very happy living in the rural town of Canton Center, Conn., while designing industrial boiler systems for Combustion Engineering, Inc." Howard recently announced his engagement to Carol Muti (Wellesley '77), and the wedding is planned for November. . . . **William P. Lull** is working for James Associates Architects/Engineers as a coordinator for integration of building systems in commercial and industrial projects, also doing acoustics and energy-conscious design.

Two very good friends of mine, **Teresa Costanza Nolet** and hubby Dan, '77, recently accepted job offers from Corning Glass Works in Corning, N.Y. They'll be moving out there in mid-June, after Teresa finishes her masters in materials science at the 'Tute. Cambridge will never be the same. . . .

As for your workaholic secretary (I bet most of you never thought anyone would call me that), finals start in the wink of an eye, and after that it's off to Cambridge for the summer. If any of you are in town for graduation or Technology Day drop me a note and I'll be sure to start some rumors about you. Keep those cards and letters coming, folks! — **David Browne**, Secretary, 17 Elm St. #4, Cambridge, MA 02139, (617) 661-0668

The President's Science Advisor Sees Strong Commitment but Vexing Issues for Science

The conflict between present needs and future plans motivates federal policymaking in every field, and science is no exception.

"Political power — the ability of government to function — rests on the gratification of near-term needs. But government's actions motivated by these needs has to be consistent with long-range interests," says Frank Press, the president's science advisor. The search for the right balance between present and future is a constant preoccupation of President Jimmy Carter, and it's been the controlling issue in science policy, too, for Dr. Press and his boss in the two years they've been working together in Washington.

Dr. Press — he is on leave from his post as Robert R. Shrock Professor of Geophysics at M.I.T. — celebrated the second anniversary of his appointment in Washington by returning to the Institute for a record-breaking gathering of the Alumni Council on April 27. It was less than a week after President Carter had issued what Dr. Press called "one of the most comprehensive statements on science policy ever made from the White House," and his speech at M.I.T. was a summary of Dr. Press' own views on the same nine major policy issues:

□ **Energy:** nowhere is the conflict between present need and future interest more dramatic, said Dr. Press. Because there is so much uncertainty about the supply and cost of energy, energy policy and the amount and form of energy research are among his office's most vexing problems — "a major issue of our time," he declared. The only sensible course, he said, involves taking many risks in the face of great uncertainty: Shall we invest in further development of old, marginally economic energy systems or in basic research seeking wholly new, more efficient systems? What role for government, and what for industry, in such work?

□ **Basic research:** the president's outstanding support of basic research — \$4.6 billion in the proposed budget for fiscal 1981, up 25 per cent in two years — represents a major investment in the future. Embodied in it are plans to "bring basic research back to the mission agencies" — the Departments of Defense, Energy, Interior, and the like — to reduce red tape, and to speed the grant process, said Dr. Press — all in the interest of reducing the cost and increasing the efficiency of basic research work.

□ **Innovation:** When he spoke late in April, Dr. Press said he was anticipating the results of a major study of innovation and entrepreneurship "within the month." He hopes it will point the way to eliminating disincentives to innovation and to restoring the productivity of "yankee ingenuity."

□ **Regulation:** Is "excessive regulation" — more than is needed to protect the public health and safety — stifling innovation and entrepreneurship in some fields of science and technology? The question is high on Dr. Press' agenda, but he gave no hint of an answer.

□ **Agriculture:** After a decade and more of stunning growth, the productivity



When Frank Press, science advisor to President Jimmy Carter, returned to M.I.T. as speaker at the Alumni Council meeting on April 27, he had been in Washington exactly two years. In that time he has clearly won the confidence of President Carter, and he has come to a deep appreciation of the policymaking issues in science and technology. Central among them, he told alumni that night, is the conflict between present needs and future interests. (Photo: Calvin Campbell)

Wolfe and Fox: New Chair and Its New Occupant



M. S. Fox

A new chair in molecular biology, named for its donor, has been established at M.I.T. by Lester Wolfe, '19, president of William J. Rountree Co., Inc., of New York City; and its first occupant is Professor Maurice S. Fox, a pioneer scientist in the field whose present work is on genetic materials and mutagenesis.

Mr. Wolfe's undergraduate degree was in physics. After World War I service he returned to M.I.T. for advanced work in aeronautics and aircraft instrumentation, and he continued in that field until the end of World War II. Then family ties brought Mr. Wolfe into the Rountree Co., where he is credited with a significant role in the revolutionary changes brought to the shipping industry by containerization.

Dr. Fox came to M.I.T. from Rockefeller University in 1962; his graduate degrees in chemistry are from the University of Chicago (Ph.D., 1951). Mr. Wolfe has an active association with Rockefeller University, where he is sponsoring two post-doctoral fellowships; and he hopes that his gifts will strengthen the cooperation between Rockefeller and M.I.T. Besides his research in molecular biology, Dr. Fox shares with Mr. Wolfe an active interest in health policy and practice. He's a member of M.I.T.'s Committees on Radiation Protection, Radiation Exposure to Human Subjects, and Assessment of Biohazards; Walter A. Rosenblith, Provost, who announced the new chair and its occupant, says Dr. Fox "has had a major influence on the intellectual life of the Department of Biology."

of American agriculture is stalling. "Significant improvements" will come from research on new crops and new methods of growing them.

□ **Human health:** A new thrust, away from clinical research into studies of the causes of disease, signals a new strategy for controlling the cost of medical care: emphasize prevention instead of treatment.

□ **Space:** Dr. Press' office is hard at work on a "comprehensive" policy and strategy to "reap major benefits from our investments in space." The space shuttle is a key element in the strategy, since it will vastly reduce the cost of many space-borne activities; new uses for satellites and even space manufacturing were also mentioned.

□ **International science:** As the scale and cost of scientific research increase, the U.S. will increasingly emphasize international cooperation in major projects. Already Japan, Germany, and U.S. industry have joined with the U.S. government to build a major synthetic fuel plant, and a similar consortium was mentioned by Dr. Press in the field of fusion.

□ **National security:** Defense science presents a microcosm of all the conflicting goals and strategies for science as a whole, said Dr. Press. We seek at once to maintain our own leadership in military technology, to reduce costs, to pursue arms limitation treaties, and to prevent other nations from advancing their military process. Technology figures in all this: "even arms control itself has become a matter of high technology," said Dr. Press.

Given such a crucial list of issues, said Dr. Press, it's obvious that "much of the country's future depends on how political, industrial, and educational leaders embrace science and technology." He spoke with confidence of his relationship with President Carter and of the president's determination to provide resources for science and technology to fulfill their promise for the future. — J.M.

Four Alumni in Congress

Two new members of the House of Representatives seated early this year are M.I.T. graduates, and they bring to four the number of alumni serving on Capital Hill. The new Congressmen are:

□ **Donald L. Ritter**, Sc.D. '66, Republican from Coopersburg, Penn.

□ **Howard E. Wolpe**, Ph.D. '67, Democrat from Lansing, Mich.

Their M.I.T.-alumni colleagues are:

□ **Les Aspin**, Ph.D. '65, Democrat from Racine, Wisc.

□ **Fortney H. Stark, Jr.** '53, Democrat from Oakland, Calif.

Until his election, Representative Ritter had been manager of research program development at Lehigh University, his under-

graduate alma mater. His M.I.T. thesis was in the field of high-temperature metallurgy, and Dr. Ritter had taught in that field at Lehigh before assuming administrative duties.

Representative Wolpe came to M.I.T. from Reed College (B.A. 1960) and Western Michigan University, where he had taught political science and developed a special interest in political change in Africa. The latter was his subject of concentration in the Political Science Department at M.I.T.

Individuals Noteworthy

Harry H. Meyer, Jr., '48, elected a vice president of Crouse-Hinds Co. . . . **Albert W. Parsons**, '41, appointed to the staff of Childs, Bertman, Tseckares and Casen-



F. J. Adams

F. Eugene Davis IV

M.I.T. '55 S.B. Physics
Harvard Law School '58 L.L.B.

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dino, architects, landscape architects and planners ... **Francis M. Staszsky**, '42, a member of the Visiting Committee for the Department of Nuclear Engineering at M.I.T., elected president of Boston Edison Co. ... **Robert O. Bigelow**, '49, named vice president of New England Power Co. ... **Harold J. Parmelee**, '60, elected vice president and named general manager of the Boston office of Turner Construction Co.

James I. Stockwell, '52, named a senior vice president of executive search firm Heidrick and Struggles ... **R. Douglas Watson**, '48, named executive vice president for national markets of A.T.&T Long Lines ... **Samuel M. Tennant**, '50, elected group vice president of the Development Group at the Aerospace Corp. ... **Harvey M. Brownrout**, '56, promoted to assistant general patent counsel for reprographics at Xerox ... **Nelson R. Disco**, '57, appointed manager of ocean engineering for Sanders Associates ... **Robert H. Brown, Jr.**, '54, elected president of Belding Heminway Co.

Robert E. Efimba, '63, assistant professor of civil engineering at Howard University, appointed to the eight-member Architect-Engineer Evaluation Board of the Pennsylvania Avenue Development Corp. ... **Page S. Ufford**, '44, design project manager at E. I. du Pont de Nemours, to chair the Equipment Testing Procedures Committee of the American Institute of Chemical Engineers ... **John C. Avallón**, '48, president of the G.T.E. Lighting Group, elected to Shawmut Merchants Bank's board of directors.

To **Joseph G. Gavin, Jr.**, '41, president of the Grumman Corp., the first Long Island Technology Leadership Award from Polytechnic Institute of New York ... **David Bushnell**, '60, staff scientist at Lockheed, named Outstanding Engineer for 1978 by the San Francisco Section of the American Institute of Aeronautics and Astronautics ... to **James R. Falendar**, '65, senior research specialist with Dow Corning, the Best Paper Award of the American Chemical Society for his co-authored paper, "The Effect of Cross-Link Distribution on Elastomeric Properties."

To **John William Gadzuk**, '63, theoretical research physicist at the Commerce Department's National Bureau of Standards, the Arthur S. Flemming Award.

Frederick J. Adams, 1902-1979

Frederick J. Adams, professor of city planning emeritus, who taught the first course in that field ever given at M.I.T. and then guided the development of the new Department of City and Regional Planning for its first 13 years, died in Toledo, Ohio, on March 25 after a brief illness. He was 77 years old.

Professor Adams was born in London and graduated from the Columbia University School of Architecture in 1925; he joined the M.I.T. faculty seven years later, and for 38 years thereafter he taught in the new field of city planning. For 26 of those years he conducted a Special Summer Program in the field that attracted registrants from throughout the world.

Though he retired in 1964, Professor Adams continued teaching until 1970; he then returned to England for seven years and finally moved to Toledo in 1977.

In addition to his teaching, Professor Adams formed a consulting firm with two faculty colleagues — Adams, Howard and Greeley (later Adams, Howard, Opperman) — that planned city and community developments throughout the world. In this way Professor Adams contributed to such notable urban developments as the transformation of Scollay Square into Boston's Government Center, the development of a metropolitan plan for San Francisco, the siting for the United Nations in New York, and the planning of Ghandidham, a new port city in India.

Professor Adams was twice president of the American Institute of Planners, now the American Planning Association, and he twice received the group's distinguished service award; he also held the Silver Award (1978) of the American Society of Planning Officials.

Henry A. Hill, 1916-1979

Henry A. Hill, Ph.D. '42, founder and president of Riverside Research Laboratories, Inc., Haverhill, Mass., who had been a member of the M.I.T. Corporation since 1977, died suddenly on March 17. He was 63.

Prior to his election to the Corporation, Dr. Hill had been a member of Corporation

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Visiting Committees for the Departments of Chemistry and of Materials Science and Engineering; Howard W. Johnson, chairman of the Corporation, called him "a distinguished scientist whose example will be deeply missed."

Dr. Hill founded his own firm in 1961 to provide research, development, and consulting services in organic chemistry; previously he had worked with several chemical research and consulting firms. He was an outspoken champion of minorities in the chemical profession — an interest which brought him election as president of the American Chemical Society in 1977-78.

Horatio C. Sexton, 1898-1978

Captain Horatio C. Sexton (U.S.N. Ret.), S.M. '23, associate professor of naval architecture at M.I.T. from 1950 to 1953, died at Anne Arundel General Hospital, Maryland, on December 26, 1978. He was 81.

Captain Sexton was a member of the Class of 1920 at the U.S. Naval Academy, and he served on active duty in the Navy (including assignments to the faculty of the Academy) from then until retirement in 1950. After leaving M.I.T. he was a member of the Central Intelligence Agency until 1961.

Beatrice Paipert, 1900-1979

Beatrice Paipert (Mrs. Julius G. Finn), '51, an artist whose sculptures are familiar in the M.I.T. community, died in Boston on April 15.

Ms. Paipert studied with Professor Gyorgy Kepes at M.I.T., and later she returned to the Institute's classrooms for work in photography with Professor Minor White and theater arts with Professor Joseph Everingham. Her busts of the late Professors Norbert Wiener and Minor White, of James R. Killian, Jr., '26, and Julius A. Stratton, '23, are familiar to many at the Institute.

Deceased

Howard P. Barnes, '06; October 2, 1973; 6 Carver St., Plymouth, Mass.

Harry R. Draper, '07; February 8, 1979; 32 Washington St., Ayer, Mass.

Mrs. Maude Parlin, '07; February 27, 1979; 193 Cadmans Neck Rd., Westport, Mass.

Claude O. Brown, '08; April 23, 1979; 1200 Hibiscus Ave., Apt. 701, Pompano Beach, Fla.

Miles Sampson, '08; March 3, 1979; 925 New Boston Rd., Fall River, Mass.

Benjamin W. Pepper, '09; March 15, 1979; c/o John B. Pepper, 89 Broad St., Boston, Mass.

Thomas Spooner, '09; April 13, 1979; R.D. 5, Box 58-A, Ft. Meyers, Fla.

Herbert H. Calvin, '12; February 19, 1979; 114-B Via Estrada, Laguna Hills, Calif.

Walter P. Green, '12; March 13, 1979; 407 S.E. Bonita Ct., Palm Bay, Fla.

John Hall, '12; October 28, 1978; 5142 Elmwood Pl., Downers Grove, Ill.

J. Vincent MacDonough, '12; October 20, 1973; 28 Whitcomb St., Watertown, Mass.

Henry C. Thierfelder, '13; February 12, 1977; 18 Myrtle Ave., Warwick, R.I.

Francis Whitten, '14; March 6, 1979; 106 Dover St., Medford, Mass.

Bertram E. Adams, '15; December 19, 1978; c/o E. A. March, 601 Academy Ave., Sewickley, Penn.

James H. Devine, '15; March 15, 1979; 2026 Kenilworth Ave., Wilmette, Ill.

Gilbert L. Peakes, '15; September 17, 1978; c/o Farquhar, 120 Green Ridge Dr., Monongahela, Penn.

Walter D. Binger, '16; March 17, 1979; 180 E. 75 St., New York, N.Y.

Willard C. Brown, '16; April 14, 1979; 602 Grove Ln., Santa Barbara, Calif.

Levering Lawrason, '16; April 1, 1979; 8528 Lubec St., Downey, Calif.

Howard M. Smith, Jr., '16; January 8, 1979; 631 Jaeger Dr., Delray Beach, Fla.

William J. Ahearn, '17; October 31, 1978; 48 Cedric Rd., Centerville, Mass.

Prof. Clifford E. Lansil, '17; April 7, 1979; 48 Oakland Ave., Arlington, Mass.

Paul C. Leonard, '17; August 25, 1978; Halcyon Farm, Lakeville, Mass.

Samuel Barron, '18; March 31, 1979; 712 Eastwind Dr., N. Palm Beach, Fla.

Hall Nichols, '18; March 27, 1979; Siders Ln., Falmouth, Mass.

Edward A. Richardson, '19; October 18, 1978; 53 E. Market St., No. 2, Bethlehem, Penn.

Eaton Webber, '19; October 27, 1978; 20 Holden Rd., W. Newton, Mass.

Richard H. Gee, '20; January 26, 1979; 346 Smith Neck Rd., S. Dartmouth, Mass.

William H. Preston, '20; April 3, 1979; 131 Nagel-San Ramon, San Juan, P.R.

Capt. Alfred H. Baisley, '21; March 17, 1979; 331 Maple Ave., Reedsville, N.C.

Donald B. Carter, '21; March 11, 1979; 465 Goodale Hill Rd., Glastonbury, Conn.

George F. Gokey, Jr., '21; February 20, 1979; 6701 Dorchester Rd., No. 906, Charleston, S.C.

Dana E. Kepner, '21; March 11, 1979; 82 Jasmine St., Denver, Colo.

Rodman McClintock, '21; March 7, 1979; Park Mansions, Pittsburgh, Penn.

Raymond A. Snow, '21; March 22, 1979; 818 Bryan St., Raleigh, N.C.

Philip A. Willis, '21; March 21, 1978; 118 Rosewood Dr., Metairie, La.

George Piers Brookfield, '22; March 25, 1975; 724 Burns St., Forest Hills, N.Y.

Clarke T. Harding, '22; February 20, 1979; 20 W. Lucerne Cir., Apt. 103, Orlando, Fla.

Russell Hopkinson, '22; March 27, 1979; P.O. Box 1586, E. Hampton, N.Y.

Kenneth F. Morgan, '22; March 15, 1979; P.O. Box 211, Newport Beach, Calif.

Frank L. Youngs, '22; April 5, 1979; 5930 E. Anaheim, Mesa, Ariz.

Dr. Joseph L. Hetzel, '23; April 30, 1979; 546 Breakneck Hill Rd., Middlebury, Conn.

George Joseph Tzougros, '23; June 12, 1978; 216-26 113 Dr., Queens Village, N.Y.

Silvio C. Massari, '24; March 25, 1979; R.F.D. No. 1, Dundee, Ill.

J. Weston Pratt, '24; September 17, 1978; 9475 Flinn Springs Ln., El Cajon, Calif.
 Lt. James P. Shovlin, '24; March, 1963; 3526 Greenward Rd., Los Angeles, Calif.
 Dr. Frederick W. Cunningham, '25; December 20, 1978; 56 Hubbard Ave., Stamford, Conn.
 Walter C. Woodman, '25; April 14, 1979; 367 School St., Watertown, Mass.
 Frederick John Dykstra, '26; April 8, 1978; 3106 Linwood, Apt. 20B, Royal Oak, Mich.
 Arthur W. Smith, '26; 1972; 89 High St., Wareham, Mass.
 Str. Edward of Sacred Heart, '29; April, 1977; Emmanuel College, 400 the Fenway, Boston, Mass.
 Wheaton W. Kraft, '29; August, 1978; c/o Mrs. David R. Schultz, Rt. 17, Box 29, Ft. Myers, Fla.
 Erasmo Reyna, '29; November 10, 1973; Avenida 28 de julio 562a, Miraflores, Lima, Peru
 Malcolm Bruce, '30; October 5, 1970; 9 North St., Plymouth, Mass.
 Samuel Koren, '30; March 13, 1979; 902 de Vere Dr., Silver Spring, Md.
 John C. Kucharik, '30; September, 1978; 5737 N. Rogers Ave., Chicago, Ill.
 Lauri A. Lindell, '30; March 15, 1979; 471 Waltham St., Lexington, Mass.
 Robert P. Schweyer, '30; May 17, 1978
 Lt. Col. Arnold Boogher, '31; March 8, 1979; 610 Via Vista Dr., Redlands, Calif.
 Elliot F. Childs, '31; February 11, 1979; 7 Harvard St., Wellesley, Mass.
 Francis A. Gregory, '31; February 27, 1977; 4015 Massachusetts Ave. S.E., Washington, D.C.
 William H. Harig, Jr., '31; February 21, 1979; 1468 Indian Ridge Tr., New Richmond, Ohio
 John W. Smith, Jr., '31; March 19, 1978; 14 Lawn Ave., Portland, Maine
 Joseph P. Fahey, '32; March 30, 1979; 9127 Champlain Ave., Niagara Falls, N.Y.
 Alan B. Fisher, '32; May 27, 1978; 1360 Race St., Denver, Colo.
 Howard H. Imray, Jr., '32; November 3, 1978; 3483 Gulf Shore Blvd. N., Naples, Fla.
 Col. Norman E. Poinier, '32; January 19, 1975; 7920 Rockwood, Apt. 123, Austin, Tex.
 Edward L. Lockman, Jr., '33; March 18, 1978; 42 Robert Cir., Providence, R.I.
 Robert W. Olsen, '33; February 1, 1979; 2601 Congress Gardens Rd., Winter Haven, Fla.
 Arthur B. Fox, '34; February 1, 1979; 15 Duxbury Hgts., P.O. Box 71, Fairport, N.Y.
 Prof. C. Sherman Grove, Jr., '34; February 8, 1978; Karma R.F.D. 3, Box 396, Charlottesville, Va.
 G. Roy Thompson, '34; January 29, 1979; 350 Windemere Rd., Rochester, N.Y.
 Henry S. Bromley, Jr., '35; January 30, 1979; P.O. Box 369, Conshohocken, Penn.
 Milton K. McLeod, '35; February 18, 1979; Brimstone Corner Rd., Hancock, N.H.
 William W. Seary, Jr., '35; February 15, 1979; 3 Meadowcroft Rd., Radnor, Penn.
 Dr. Frederick Howard Carten, '36; De-

ember 7, 1978; 251 S.W. 7 Ave., Boca Raton, Fla.
 George F. Cary II, '37; August 17, 1978; 990 Washington St., Bath, Maine
 Col. John B. Corbett, '37; August 16, 1978; 3321 Grass Hill Terr., Falls Church, Va.
 R. Adm. Manuel E. Gimenez Figueroa, '38; November 21, 1978; Coronel Diaz 1775 60 Piso, Buenos Aires, Argentina
 Joseph R. Krenn, '38; February 28, 1979; 22 Cedarwood Dr., New Britain, Conn.
 Norman Macbeth, Jr., '39; March 13, 1979; 20 Shoreline Rd., Darien, Conn.
 John M. Coombs, '40; July 7, 1977; 19 B. Muldowney Cir., Poughkeepsie, N.Y.
 Donald J. Dixon, '41; January 31, 1979; 14341 Leaning Pine Dr., Miami Lakes, Fla.
 R. Adm. D. Roderick Frakes, '41; January 29, 1979; Magnolia, Minn.
 Col. Clarence H. Gunderson, '41; June 27, 1978; P.O. Box 827, Indian Lake Estates, Fla.
 Frank M. P. Sexton, '41; January 25, 1977; 136 State St., Newburyport, Mass.
 Dr. Henry A. Hill, '42; March 17, 1979; Riverside Rsch. Labs, 300 Neck Rd., Haverhill, Mass.
 Cmdr. John B. Jorgensen, '42; December 7, 1978; South Bristol, Maine
 William A. Horton, '42; September 27, 1978; 833 Skylark Ln., Worthington, Ohio
 Benjamin S. Kingsbury, '42; January 29, 1979; P.O. Box 9544, Marina del Rey, Calif.
 John F. Reeves, '42; February 14, 1979; 3264 Clifton Ct., Palo Alto, Calif.
 Dr. Richard A. Craig, '44; September 1, 1978; 2326 Amelia Cir., Tallahassee, Fla.
 Harry S. Myers, Jr., '44; April 1, 1979; 20529 Rancho San Jose, Covina, Calif.
 Richard B. Palme, '44; October 2, 1978; 59 N. Main St., Flemington, N.J.
 Anthony J. Szykiewicz, '44; November 22, 1978; 141 St. Marks Pl., Staten Island, N.Y.
 William J. Duffey, '45; December 6, 1978; 5236 Cheves Warow Rd., Cincinnati, Ohio
 David E. Gates, '46; January 22, 1979; Franklin, Vt.
 Irving C. Bailey, '47; February, 1978; W. Barnet, Vt.
 Vincent P. Goddard, '47; July 26, 1977; 1020 Stanfield St., S. Bend, Ind.
 Hugh H. Lavery, '47; December 17, 1978; 7 Paris Ave., Corinth, N.Y.
 John C. Adams, Jr., '48; April 28, 1979; 722 Spanish Drive S., Longboat Key, Sarasoto, Fla.
 George Bamber, '48; November 11, 1978; 2918 S.W. 119th, Seattle, Wash.
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 Joseph F. Regan, '50; April 12, 1979; 97 North St., Lexington, Mass.
 Donald S. Whitmore, '51; April 10, 1978; 149 W. Concord St., Boston, Mass.
 Dr. John W. Wright, '51; April 27, 1979; Route 1, Box 176, Accokeek, Md.
 William L. Carpenter, '56; March 6, 1979; 1715 Ocean Dr., Apt. 4C, Vero Beach, Fla.
 Beatrice P. Finn, '61; April 15, 1979; 10 Criggs Terr. Brookline, Mass.
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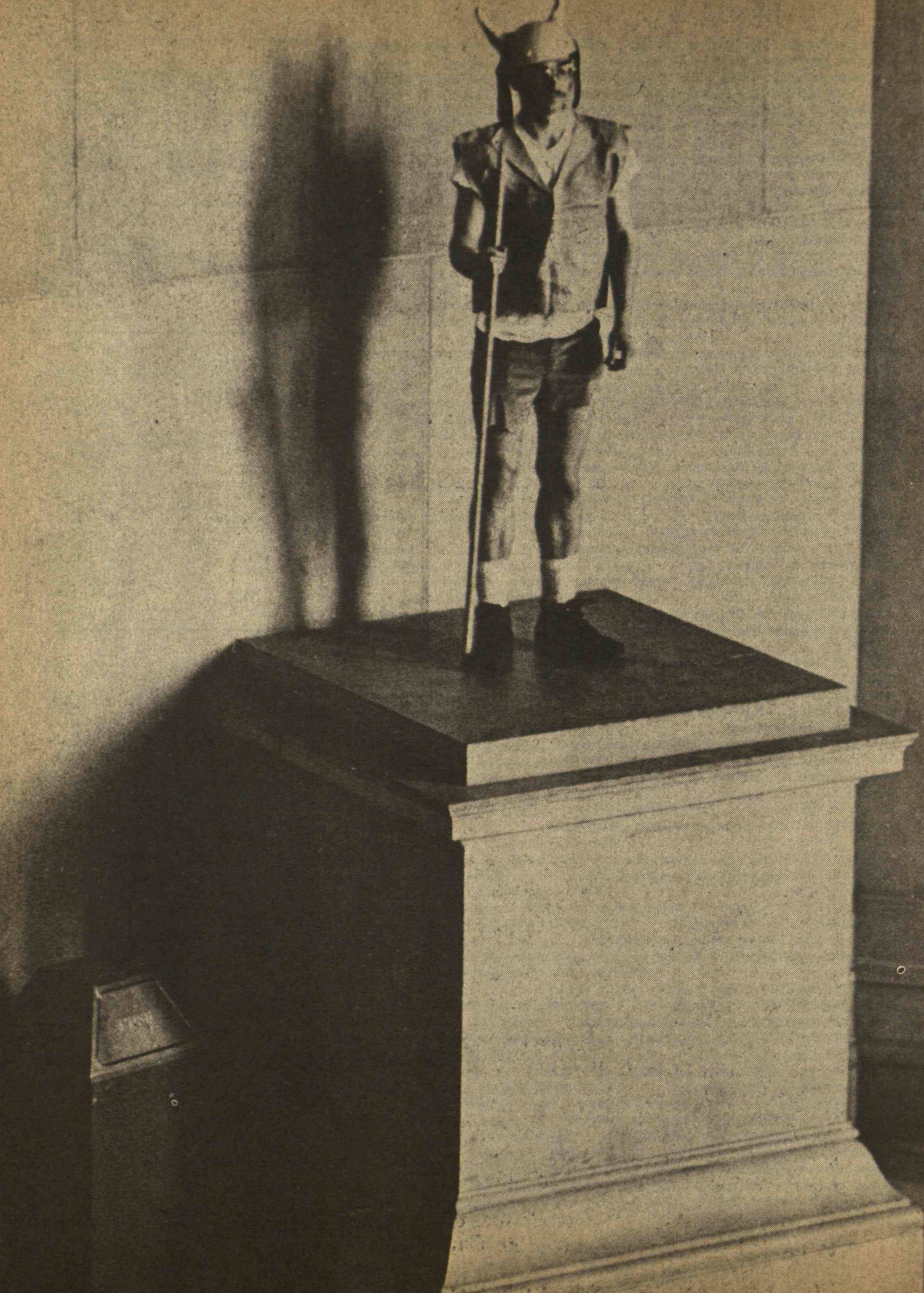
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Under the Domes

Pedestal in need of a statue. Remember those empty pedestals in the four corners of the lobby of building 7? One of them was occupied for several hours this spring by Eric Willmer, '82, costumed as a Viking warrior (but wearing shorts), to the surprise of observant passers-by. Visiting Mr. Willmer early in the spring, his father remarked on the empty pedestals; and Mr. Willmer thought his "random happening" (his phrase) would help solve the problem. (Photo: Calvin Campbell)

Sniffing Victory with \$205 Million, the Leadership Campaign Resets Its Sights

On its fourth anniversary at the end of April, the five-year M.I.T. Leadership Campaign stood at \$205 million — short only \$20 million of its original \$225 million goal.

Already it is the third largest capital fund-raising project ever completed by a major U.S. university, Howard W. Johnson, Chairman of the Corporation, told members of the Alumni Council. But the enthusiasm of his report was balanced with "a certain amount of prudent caution," he told the alumni: the final portion of any fund is the hardest, and — because of inflation and unforeseen new priorities — more than \$20 million is in fact needed to meet Leadership Campaign goals and other urgent purposes. "Many critical needs remain unmet," said Mr. Johnson.

Clearly, the Campaign will not be considered a complete success unless it considerably exceeds the original \$225 million goal by April, 1980.

Old Needs Unmet, New Needs Added

Among remaining needs in the major campaign areas:

□ *Endowed professorships.* Campaign goals included 50 endowed professorships, and 30 have thus far been established (and a few more are in discussion with potential donors). "Endowed support for the faculty provides the real underpinning of the Institute's intellectual strength," said Mr. Johnson.

□ *Student aid.* The \$10 million for this purpose in the original campaign goals "was very much a minimum" four years ago, Mr. Johnson said, and "subsequent events have made it — quite frankly — obsolete." As tuition advances under the pressure of inflation, M.I.T.'s ability to provide adequate loan and scholarship support is "seriously jeopardized." Indeed, said Mr. Johnson, "insufficient resources force us to draw from general funds and borrow heavily from commercial banks to meet student need each year."

□ *Unrestricted funds.* Of the original \$20 million goal, \$13 million has been contributed. Unrestricted funds "hold the key to M.I.T.'s continued ability to respond to new challenges with speed and flexibility," said Mr. Johnson — "in short, all those things that are necessary to keep M.I.T. a top-ranked institution."

□ *Student housing.* There's been "no substantial support" through the Campaign for the \$10-million new student house. "We must find it," Mr. Johnson said. In addition, new capital is needed by both the Independent Residence Development and Campus Residence Funds to refurbish and improve existing fraternities and dormitories.

□ *Athletics.* Campaign goals included a \$7.9 million center for athletics and special events, toward which only \$5.4 million is in hand.

□ *Energy.* Just over \$5 million of the \$7.5 million originally specified for support of the Energy Laboratory and its Center for Energy Policy Research is in

\$11.5 Million from the Aga Khan for Muslim Studies in Cambridge

There's a "striking paucity of men and women able to understand and cope with the practical, cultural, social, and aesthetic needs of an evolving Muslim world," says the joint announcement from Harvard and M.I.T. Hence the gift to the two institutions of at least \$11.5 million from His Highness The Aga Khan, who was a member of Harvard's class of 1958.

Most of that fund will be used as endowment to support four professorships in Islamic art and architecture, two at each institution. There will be important additions to materials in Islamic architecture at Harvard's Fogg Museum Library and M.I.T.'s Rotch Library, a fellowship program for doctoral students at the two institutions, and a series of faculty exchange fellowships.

All these activities will be launched by two summer institutes in Cambridge — one on architectural education in the Muslim world (1980) and one on architectural practice there (1981).

The idea is to assure outstanding teaching and research in the field of Muslim architecture at Harvard and M.I.T., to improve scholarship in the field, and to help architects and teachers in the Moslem world make Islamic architecture "more responsive to the values and aesthetic traditions of Islamic culture."

When Norman Skelton (right), corporate manager for staffing and recruiting for Motorola, Inc., was on the campus this spring, he asked for an appointment with President Jerome B. Wiesner. Turns out his purpose was not to hire Dr. Wiesner — who will give up his job as president of M.I.T. next June 30 — but to give the Institute a \$10,000 check, an unrestricted corporate grant from Motorola. (Photo: Calvin Campbell)



Energy Policy Endowment

A \$1 million grant from the government of Japan will establish a permanent Japanese Endowment for International Energy Policy Studies at M.I.T.

Howard W. Johnson, Chairman of the Corporation, received the good news at Blair House in Washington on May 2 from Japanese Prime Minister Masayoshi Ohira, then on a state visit to the U.S. The grant is one of several major gifts to U.S. educational and cultural organizations announced during Mr. Ohira's visit.

Income from the endowment, said Mr. Johnson, will continue and expand work such as that now underway by the M.I.T. Energy Laboratory's Program in International Energy Studies. This includes research on world oil, coal, and nuclear fuel trade and on the economic and security issues raised by growing dependence on imported energy resources by many industrialized nations.

The Japanese government will soon designate an agency or institution to become an associate of the Center for Energy Policy Research, said Professor Henry D. Jacoby, director of the center.

The Athletics-Special Events Center Goes Out for Bid

Working drawings have been completed and bids are due as this is written for the new multipurpose athletics-special events center which is a major goal of the Leadership Campaign.

Though funding was incomplete (see right), the M.I.T. Corporation gave the go-ahead for drawings and bids at its January meeting, according to Gordon R. Haff, '79, writing in *The Tech*. Howard W. Johnson, Chairman of the Corporation, is quoted as saying the Corporation's Executive Committee felt that "the new facility is a first priority for student activities, so they gave the go-ahead even though all the money was not yet in." The likelihood that a delay would expose the project to inflation in construction costs was another factor motivating the decision, Mr. Johnson said.

hand. The balance is critically needed by M.I.T., just as the nation critically needs new energy technology and policy.

□ **Engineering.** Enrollment in M.I.T.'s School of Engineering ("its rating remains first in the nation," Mr. Johnson noted) has nearly doubled in six years as young men and women see new needs and hence new opportunities in this profession. A special goal of \$10 million within the Leadership Campaign is to support new, young engineering faculty, but just under \$2 million is now available.

□ **Health sciences, technology, and management.** A new facility for work in this field has been funded, but program support is still needed for teaching and research.

In addition to these, Mr. Johnson cited important needs in five areas and activities not originally embraced by the Leadership Campaign:

□ Increased support for faculty and facilities in the Sloan School of Management.

□ Support for a major new research and teaching effort in the brain sciences. (Research in this field "offers possibilities for an explosive increase in our understanding," Mr. Johnson said.)

□ Funds for facilities and programs in a wide range of the creative arts.

□ Support for a new program in science, technology, and society embracing "humanistic and policy issues of contemporary industrial society."

□ Program support for the Division of Study and Research in Education.

"Overwhelming Confidence" by Alumni

The \$205 million includes \$72 million from individuals, \$60 million from corporations, and \$73 million from foundations. "The strong support we have received from all these groups," Mr. Johnson told the alumni, "reflects their shared perception of M.I.T.'s important role in today's world."

Of the total, \$53 million has been received for endowment, \$51 million for facilities, and \$101 million for current use.

Counting gifts to the Alumni Fund in the four years since the Leadership Campaign was announced, over 30,000 alumni are enrolled as contributors to the campaign. "An overwhelming vote of confidence," Mr. Johnson told the Alumni Council. In the current year 1978-79, 14,494 alumni have contributed \$3,469,683 to the Alumni Fund — a modest increase over the 1977-78 fund in terms of dollars but a significant (5 per cent) increase in the number of donors. Stephen P. Denker, '59, Director of the Fund, assured Mr. Johnson that both figures would be substantially increased before the end of the current fund year. — J.M.

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Less May Be Good, But None May Be No Better, Says Dean A. Horn

Much of man's management of the oceans is guided by a fallacy that Dean A. Horn, N.E. '49, director of the M.I.T. Sea Grant Program, calls the "absurdity of absolutes."

When we don't like something, we simply decree that it must stop. In the process we assume that if less is better, zero is best — or, conversely, "if a little is good, a lot must be better."

As examples of the "absurdity of absolutes" in action, Mr. Horn cites "the so-called 'clean-water' and 'clean-air' acts which prescribe 'zero effluent' requirements.

"What I think we really mean is cleaner water — cleaner by some standard that is technically sound," he says. If we try to do more than that, reaching for the "absurd absolute," we simply waste resources, lose opportunities, and in some cases unnecessarily improve on nature.

Mr. Horn's statement came this spring as he received the David B. Stone Medal of the New England Aquarium for "distinguished service to environment and community." He's been associated with the administration of M.I.T.'s Sea Grant program since its establishment and has been its director since 1975.

For examples of the "absurdity of absolutes" in action, Mr. Horn cited current controversies on ocean pollution. The Marine Protection, Research and Sanctuaries Act (the "ocean dumping" act) "legislates the end of ocean dumping by December 31, 1981," he said. "At the absolute, this says we must stop using almost three-fourths of the available space on earth and concentrate all our wastes, all our pollution, on the one quarter we call land. I say such an approach is ridiculous."

Two examples, said Mr. Horn, of the "ocean dumping" act's irrationalities:

□ It would prohibit use of sea-floor deposits for radioactive waste disposal. Clay deposits from 200 to 4,000 meters thick lie on the abyssal plains, and they are "extremely stable . . . one of the most stable areas in the ocean. The technology to place cannisters of radioactive wastes at the bottom of these clays and to seal them in place certainly exists today. Even if the cannisters fail after several centuries, or even decades, the dense clays could act as nature's cannister."

□ The act would endanger offshore oil exploitation. Today "offshore oil production from about 18,000 holes is responsible for only 1.3 per cent of the total oil in the ocean," said Mr. Horn; at least seven times as much oil enters the ocean from natural oil seeps. If the "no oil in the ocean" goal prevails, we may be denied a vital offshore resource for no logical environmental reason.

The problem, said Mr. Horn, is to "study and understand what are the ocean's capacities and limits — and how these limits change with time."

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The Earth and Its Humans as a Finite System

Question, from an M.I.T. undergraduate: "Should scientists really keep on making our society more and more complex? What should we do to be responsible scientists?"

Response, from the podium: "You should try as hard as you can to understand the impact of what you are doing. This means looking for alternatives, analyzing what they mean, and developing a sense of time.

"I believe we must think of our society as a learning system. We have to be flexible. We can observe our problems, try to learn from them, and make corrections. For example, my own feeling is that we have a decade, more or less, to learn about the CO₂ problem. This means we should study it, but we don't have to panic about it."

That response was from President Jerome B. Wiesner, who turned professor for two hours late in the spring term to speak to some 50 students and "listeners" in a new, interdepartmental one-semester course called "The Finite Earth: Towards a More Just, Sustainable, and Participatory Society."

The idea was this, said Professor David J. Rose, Ph.D. '50, of the Department of Nuclear Engineering and Nicholas Herman, instructor in the School of Humanities and Social Science in the description circulated last winter as the term began "... to explore interdisciplinary topics normally outside the scope of any course or department, chosen for their relevance — each and all together — to a larger perspective on the ... prospects of the human community and its earth."

In 27 meetings there were a total of 20 lectures by M.I.T. faculty and guests and seven discussion sessions. Six departments collaborated in the course; expenses for it were covered mainly by a grant from the Provost's office, but to cover a small overrun, Professor Rose asked each department to ante up \$200. "If we don't get it," he said, "I'll have to hit up the Provost for that too." The organizers brought an astonishing array of guest speakers to the campus:

- ☐ Georgio Solimano of Columbia University on the political economy of nutrition.
- ☐ Tjalling Koopmans, Nobel Prize winner in economics, 1975, of Yale University on economics and social choice.
- ☐ Philip Palmado of the State University of New York at Stony Brook on the effect of energy on rural development throughout the world.
- ☐ Dan Gross, professor of anthropology at Hunter College, on food supply and energy use.
- ☐ Shoukri Roweis of the University of Toronto on professional training appropriate to third-world development.
- ☐ Denis Goulet of the Overseas Development Council on the role of multinational corporations in overseas development.
- ☐ Seymour Melman of Columbia University on industry and the arms race.
- ☐ Canon Burgess Carr, general secretary of the All-Africa Council of Churches (Nairobi), on "The West and the Rest of Us."

How a Learning System Can Learn from Failure

Preparing for his appearance as a lecturer, President Wiesner said he had done a "back-of-the-envelope" calculation: for each person on earth there are seven acres of land. Not much, considering what he thinks are the four real requirements for every human's survival: energy, communication, raw materials, and a sense of "shared purpose" — meaning political stability.

"There is no way to escape our dependence on our environment," said Dr. Wiesner. The most important difference between developing and developed countries, he thinks, may be in the "ability of their systems to adjust and adapt." In this sense, he thinks, the availability of resources is not the crucial question: the problem is to learn to manage them.

"If you're a researcher in a laboratory," said Dr. Wiesner, "you don't

expect every experiment to work, and you plan to learn from the failures as well as the successes. Society must learn to work that way, too."

Is this idea of learning, and of the interrelatedness of things, accepted in M.I.T. classrooms? asked a student.

"You can't teach what you don't know," replied Dr. Wiesner; one of the difficulties is that "these ideas aren't found in structured disciplines." He wishes that M.I.T. could somehow have "a more coherent set of social studies."

To some in his audience, Dr. Wiesner may have seemed to ask for a course just as the one in which he was speaking. "The course fills a real void in most engineering curricula," said an undergraduate at a year-end critique session. "You never think about finite limits and political implications."



A new computer system based on D.E.C.'s VAX11/780 is now in place in the joint computer facility previously operated by the Departments of Civil and Mechanical Engineering, which have now been joined by the Departments of Aeronautics and Astronautics and of Ocean Engineering. There are 27 terminals such as those shown in this picture, and ten dial-up telephone lines give remote access from laboratories, offices, and dormitories. Professor Derek Rowell (right) of the Department of Mechanical Engineering is technical director. (Photo: Calvin Campbell)

A New VAX11/780 Computer for the Engineering School

The joint computer of the Departments of Civil and Mechanical Engineering has been upgraded, and two more departments in the School of Engineering — Ocean Engineering and Aeronautics and Astronautics — have joined in its operation.

The system's new computer is D.E.C.'s VAX11/780, with a satellite PDP11/34 for dedicated real-time processing. In addition to the main processor with one megabyte of memory, there are two disk drives giving a total of 350 megabytes of on-line storage, a magnetic tape drive for media exchange and archival storage, two 600-line-per-minute printers, and 27 terminals.

Professor Derek Rowell of the Department of Mechanical Engineering, who is technical director of the facility, says the VAX11/780 was chosen "for the ease and convenience with which students and other users can use it."

"The virtual memory feature means that the computer can support programs that are very much larger than the physical memory

on the machine. The management of large programs, including those with large data storage arrays, is completely transparent to the user," Professor Rowell explains.

He is confident that the new computer system "has sufficient power and sophistication to meet the curriculum and research computing demands of the four departments through the mid-1980s."

Engineering "Word Processor"

Six departments and two centers in the School of Engineering have joined with the office of the dean to develop a "word processing" facility to prepare technical reports, progress reports, professional papers, and other documents; the equipment will interface with phototypesetting equipment already in place at M.I.T., and as time and facilities permit services will be made available throughout the M.I.T. community.

Applications are now being accepted for the position of manager of the facility, the equipment for which will be in place during the summer.



Would this owl scare you? But that's not the point. Two members of M.I.T.'s electrical shop are attaching it to the 13,800-volt electrical substation that supplies power for the supersonic wind tunnel in the Aerophysics Laboratory; the idea is to discourage birds and squirrels, whose nests have an alarming propensity for causing short circuits.



A final exam — with all the comforts of home. The way to do your best, reasoned Paul A. Blueloch, '81, is to be relaxed. So he came to his final in introductory electronics prepared to create an environment for success: checkered tablecloth, candle, bread, cheese, and two bottles of wine. (Photo: Michel Baylocq, '81, from Technique)

Student Government: A Pledge to Improve the Quality of Life (How About a "Lobdeli"?)

As the end of his term approached, Barry Newman, '79, who was elected president of the Undergraduate Association in April, 1978, told *The Tech* that the opportunities of that job are "phenomenal."

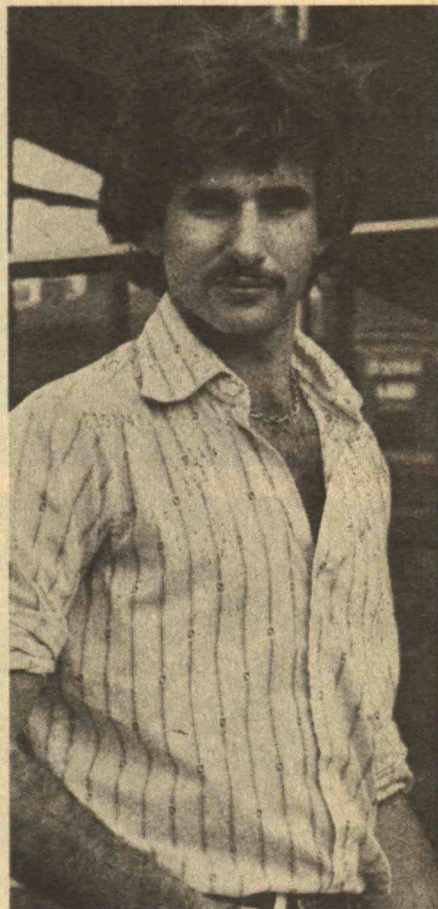
"I loved it," he said.

By any assessment, Mr. Newman's administration had been a good one — close cooperation with all parts of the Institute, a livelier sense of community than in most recent years. After spending 30 or 40 hours a week — his estimate — on the job, Mr. Newman was rewarded with a Karl Taylor Compton Prize at the Honors Convocation early in May: "... selfless and caring attention to the persons of this community. In every leadership position ... and in personal daily contacts with us, he has established new bonds of community understanding and well-being."

Student environment was the perennial subject of General Assembly meetings, and it remained a lively issue when the time came to elect Mr. Newman's successor. The victor was John Hakala, '81, who told *The Tech* his goal "is to improve the quality of individual student life." He promised an "open administration" with "a lot more avenues for student involvement" — including "beer hours" in the Undergraduate Association office to encourage visitors and talk.

A major priority will be to increase the community's sense of community, to give people more places and incentives to interact together. This means, for example, "making the Student Center into a real student center — a place where people really want to hang out," says Charles Markham, '81, new U.A. vice president. For example, how about turning the big Lobdell dining room into a collection of balconies and lounges, served by a "Lobdeli" — a sandwich bar instead of a formal cafeteria line? asks Mr. Markham.

Other items on the Hakala-Markham administration list: persuade the faculty to increase the number of courses which students can take on a pass-fail basis — one way of making M.I.T. "a little less pressure-oriented"; arrange for living group exchanges, so that each part of the campus can see how the other lives; reinstate "field day," the interclass rivalry of early fall, and develop a "homecoming" celebration around a home game by the new football club.



Barry A. Newman, '79 (above), spent most of his year as president of the Undergraduate Association fulfilling his pledge to improve student communications and student life, and he won considerable acclaim among students and administration in the process. The same pledge was made by his successor, John Hakala, '81, during his successful campaign in April. (Photo: Gordon R. Haff, '79)

John S. Oliver (right), who directs the M.I.T. Choral Society as a lecturer in music at the Institute, is a major figure in choral music in New England; he's also director of the Tanglewood Festival Chorus which frequently performs with the Boston Symphony. Of the Choral Society's *Missa Solemnis* this spring, (below), reviewer Joel West, '79, said in *The Tech* that Mr. Oliver's "experienced hand was evident throughout. . . . The chorus . . . gave an inspired performance," he wrote; "the enthusiasm of the amateur group gave a far more exciting result than is often produced by more expert choruses." (Photos: Joel West, '79, from *The Tech*)



Even without television cameras, Henry Brant's *Spatial Concerto* is a unique musical spectacle — orchestra and piano soloist on stage, choral group and other musicians at five different locations in the hall. It was performed by the M.I.T. Symphony Orchestra in Kresge in April (above) with Elon Goitein videotaping for later broadcast. Barbara Masi, '81, and Albert Ruesga, '80, had leads in the Dramashop's spring production of *The Wild Duck*. (Photos: James P. Jackson, '81, from *The Tech* and Calvin Campbell)



Music and Drama: A Busy Spring for Student Performers

As the spring term rushed to an end, the arts at M.I.T. rushed with it to a veritable crescendo of performance demonstrating both ambitions and talents that seemed more than remarkable. Among the highlights:

□ Beethoven's major choral work, the *Missa Solemnis*, was performed by the Choral Society under the direction of John Oliver. The concert was held at the Sacred Heart Church in Cambridge, and Joel West, '79, *The Tech's* reviewer, liked what he heard: "... the Choral Society, when motivated and released from its Kresge acoustical prison, is capable of a truly first-rate result."

□ For the spring concert of its 30th anniversary season, the Concert Band under the direction of John Corley chose the world premiere of "Chroma" (1978) by Pasquale Tassone and the M.I.T. premiere of "Al Fresco" (1975) by Karel Husa.

□ Three members of the Boston Symphony Orchestra — Peter Chapman, principal trumpet; Chester Schmitz, considered the finest symphonic tuba player in the world, and Thomas Gauger, percussionist — were soloists with the M.I.T. Brass Ensemble, Gordon Hallberg, conductor, in a concert of fanfares.

□ Ibsen's difficult play, "The Wild Duck," was chosen by Dramashop for its major spring production, with the principal roles going to six M.I.T. undergraduates and one Wellesley student.

□ The M.I.T. Symphony Orchestra, David Epstein conducting, provided a unique experience for its Kresge Auditorium audience with two performances — the first ever on the East Coast — of Henry Brant's *Spatial Concerto*. Elon Goitein, executive producer for Israel Television who spent the year as research affiliate with the M.I.T. Center for Advanced Visual Studies, videotaped the second performance (on April 17) for later broadcast; he said he wanted "to produce a television concert, rather than a concert that will be televised."

He had lots to work with. The composer describes his *Spatial Concerto* as a piano concerto with orchestra, isolated wind groups, and a women's chorus; they were, in fact, five performing groups scattered throughout Kresge in addition to the piano soloist (Hilde Somer) and orchestra on stage. "... a sonic dazzler," said music critic Byron Belt.

□ The M.I.T. Musical Theatre Guild ended its 1978-79 season with a smash hit in "Oklahoma!"

How to Assemble a Structure in Space

Astronauts sent aloft in the Space Shuttle are trying to assemble the beams in the Shuttle's cargo to create a solar reflector in space. In doing so, they're following a plan written in 1979 by an M.I.T. undergraduate: "Manual Alignment of Structural Components in Space," by Carolyn S. Major, '81.

When she began her work last year, Ms. Major realized that most plans for large space structures were inadequate: they didn't include details of how the beams of such structures were to be aligned and assembled. So she studied a two-part problem:

- How and at what rate will an astronaut be able to exert torque on a large beam in a weightless environment?
- How strong must the beam and its joining hardware be to withstand these forces during assembly?

Ms. Major answers both questions in her new paper — and she does it well enough to win the annual student paper competition sponsored by the American Institute of Aeronautics and Astronautics.

Governor King Dampens the Spring and Refuses the Screw

When Massachusetts' new governor, Edward J. King, turned the state dry for thousands of teen-agers (he campaigned last fall for a drinking age of 21 instead of 18 and settled for the legislature's 20-year limit effective in April), he dampened collegiate spring spirits throughout Massachusetts.

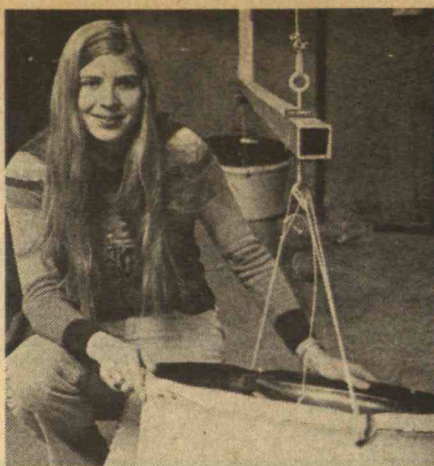
At M.I.T. the Dormitory Council and East Campus joined to present the "The Last (Legal) Party" on April 14, offering one free drink to anyone under 20. The Muddy Charles Pub began requiring identification for admission — over 20 or you can't get in. Strat's Rat — the Student Center's Saturday disco party — turned from beer to soft drinks. And everyone wondered how the fraternities would manage next fall's Rush Week.

Three weeks after the 20-year limit became law, Governor King became an early — and apparently strong — candidate for Alpha Phi Omega's "Institute screw" award. But the governor's staff found the probability of that honor less amusing than threatening, and the governor declined the nomination and sent word that — even if chosen — he would not accept. An "Institute screw" somewhat lacking in lustre finally went to Professor F. Read McFeely for his role as director of 5.31 — Introduction to Chemical Experimentation.

Uncontrolled Hack at McCormick?

McCormick Hall residents were startled by an explosion in the courtyard at 12:10 a.m. on Sunday, April 29. Twelve windows were shattered, and a large crowd of onlookers — including the Cambridge Fire Department and Bomb Squad — descended on the scene. But there were no injuries.

Completing his investigation, Captain William M. Lyons of the Campus Patrol told



Carolyn S. Major, '81, is the first woman ever to win the annual student paper competition sponsored by the American Institute of Aeronautics and Astronautics. She's shown with the apparatus she designed and used to study the forces on beams assembled in space, and the needs of astronauts called on to do the assembly work. (Photo: Calvin Campbell)

The Tech, "I think it was a hack that . . . got out of control. That's all.

"I think we're on the right track of what happened," he said. "Everything's a challenge here."

Co-ed Living Expanding . . . Slowly

Co-ed living will be extended to three more M.I.T. student residences next fall, but the Dean's Office declined to add women in Random Hall in September.

One more floor of East Campus will go co-ed; women will be accepted in Fenway House, the cooperative residence at 34 the Fenway, Boston; and up to 15 co-eds will be included in a Spanish-speaking section of New House — the section at 473 Memorial Drive which has heretofore been an all-male dormitory.

Some New House residents objected, fearing that too many students now living in New House would be displaced by those interested in the Spanish House experiment. But Robert Sherwood, Associate Dean for Student Affairs, stood firm: the many New House residents graduating in June, he said, "offered a unique opportunity to start Spanish House while displacing the fewest possible students." To disappointed co-ed advocates at Random House, Dean Sherwood explained that there would be too few spaces for women there in 1979-80; he wanted to postpone the decision for at least a year.

Largest Blood Drive in New England

A near-record total of 1,706 pints of blood went from the M.I.T. community (including the Charles Stark Draper Laboratories, Inc.) to the Red Cross in April, the result of an eight-day blood drive operated by the Technology Community Association. It was the largest total in five years — and it included a record-setting 575 pints from the fraternities.

Leaders among the living groups included Phi Gamma Delta, 97 per cent of whose members gave blood, Theta Xi (93.3 per cent), Delta Upsilon (93.1 per cent), and German House (92.9 per cent). It's by far the largest campus blood drive in New England.



When Fenway House first petitioned to become co-ed in September, Robert Sherwood, Associate Dean for Student Affairs, said no: he was concerned about the crime rate in Fenway's neighborhood. Co-ed advocates responded with Boston Police Department statistics and confirming letters from officials of the nearby Boston Conservatory of Music, while Linda Schaffir, '82, viewed the dialogue with a touch of sarcasm in *The Tech*; and Dean Sherwood presently changed his mind.

Puzzle Corner

Allan J. Gottlieb

Once More in the Never-Never Land of Zymurgy



Allan Gottlieb studied mathematics at M.I.T. (S.B. 1967) and Brandeis (A.M. 1968, Ph.D. 1973); he is now Assistant Professor of Mathematics and Coordinator of Computer Mathematics at York College of the City University of New York. Send problems, solutions, and comments to him at the Department of Mathematics, York College, Jamaica, N.Y., 11451.

John Rule has a question for those of you who have worked on Y1979 (or any other yearly problem). Are there any four digit years for which all the numbers from 1 to 100 are possible? I suspect that there are not but that the only proof anyone will submit is a blank computer output sheet followed by a large bill.

Several readers have asked about computer attempts to play games other than chess. There are efforts to computerize checkers, go, and bridge — among others. Anyone interested is referred to *Personal Computing* where there are regular articles on computerized games.

Problems

J/J 1 We begin with a bridge problem from Emmet Duffy. South, who is on lead with hearts as trump, is to take all six remaining tricks:

♠ Q J 10	♠ K 9	♠ A 8
♥ —	♥ K	♥ —
♦ 2	♦ 4	♦ —
♣ J 6	♣ A Q	♣ K 5 4 3
	♠ J 9 3	
	♥ —	
	♦ J	
	♣ A K 3	

J/J 2 For the second consecutive issue our second new problem is similar to 1977 Jan 4. This month's offering, from Norman Wickstrand, does not require knowledge of the old problem:

A dog swims directly towards his master at two miles per hour. The master is directly across the stream at the start. When the dog is two-thirds of the way across the stream his upstream velocity component equals the velocity of the river. The dog swims five minutes longer than if the water had been still. How wide is the river and what is the velocity of the water in the river?

J/J 3 We now turn our attention to a random geometry problem from William Butler: Two concentric circles are drawn. The inner

circle has a radius of one inch while the outer circle has a radius of two inches. A random chord is drawn within the outer circle by the following method. A point (p_1) is located a random distance (0 to 2 inches) at some random direction for the center. A second point (p_2) is determined by the same method. The chord is drawn through the two points. What is the probability that it will intersect the inner circle?

J/J 4 Edwin Nordstrom sends us a problem that brings back memories of the (cheap energy) days when I drove to and from California. Mr. Nordstrom writes:

I recently took a cross-country trip via car. Part of my efforts to stay awake while driving centered on the odometer. Every once in a while the six digits would show mirror symmetry; i.e., they would be in the form xyz-zyx. The question is: How often does this happen during the complete 100,000-mile sequence through the odometer? Also, is there a particular 1,000-mile trip during which it would occur more often than on any other?

J/J 5 Finally, Kenneth Wise wonders what is the longest English word (no proper nouns or chemical compounds, please) in which no letter occurs more than once — that is, all the letters in the word are distinct.

Speed Department

J/J SD1 Frank Rubin has two circular gears joined by a figure-eight belt. The intersection of the belt is n times as far from the center of gear A as from the center of gear B. What can be said about the sizes of the gears?

J/J SD2 We close with a two-part problem from P. Heftler:

A. In the class of positive integers, expressed in the ordinary decimal system, what proportion is either divisible by 3 or includes the digit 3?

B. Same as question A except that the numbers are written in base 3.

Solutions

FEB 1 Find a knight's tour; that is, with one

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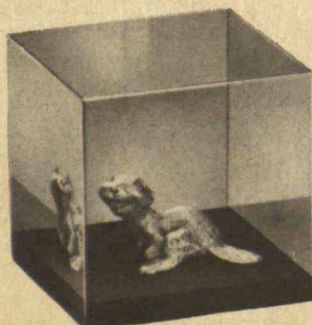
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knight placed on an empty chess board, make 63 moves that result in the knight having been on each square once.

No one attempted an uncrossed knight's tour, but several responders found closed tours — that is, the knight ends on a square from which it can move to the starting square. The following solution is from Jerome Taylor:

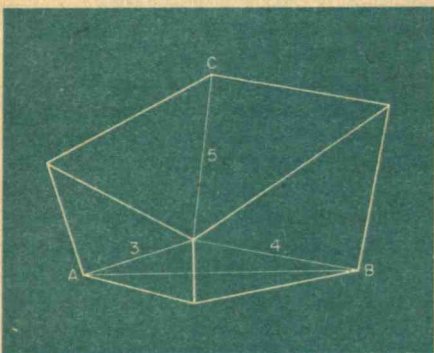
53	46	35	40	51	30	19	26
34	41	52	45	36	27	22	29
47	54	39	50	31	20	25	18
42	33	48	37	44	23	28	21
55	38	43	32	49	12	17	24
64	61	58	5	14	3	8	11
59	56	63	2	9	6	13	16
62	1	60	57	4	15	10	7

Also solved by Harry Zaremba, Ken Zeger, Richard Hess, Emmet Duffy, and Frank Rubin.

FEB 2 Given an equilateral triangle ABC with an interior point P located 3, 4, and 5 inches from A, B, and C, respectively, what is the length of a side of the triangle?

Several readers found solutions involving analytic geometry using cartesian coordinates. The following geometrical solution is from Benn Ross:

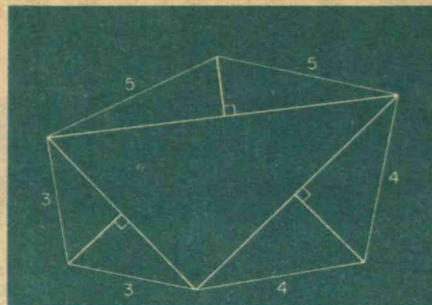
The key to solution is to note that the area of the triangle is $x^2\sqrt{3}/4$, where x is the unknown length. Direct use of area formulas leads to intractable-looking equations; however, try the following construction:



Drop perpendiculars from P to the three sides. Continue the perpendiculars an equal distance beyond the sides. Connect the points so reached with the adjacent vertices of the triangle to form an irregular hexagon (above). Since each small triangle exterior to triangle ABC is congruent to the adjacent small triangle inside ABC, it is easily seen that the hexagon has the following properties:

- Its area is twice that of triangle ABC.
- The angles at points A, B, and C are all 120° .
- The pairs of sides adjacent to A, B, and C

are each of length 3, 4, and 5, respectively. We now erase the lines within the hexagon and connect the three outer vertices. We also drop perpendiculars from A, B, and C to the three new interior lines:



We now have six 30° - 60° - 90° right triangles and an inner triangle whose sides can be seen to be $3\sqrt{3}$, $4\sqrt{3}$, and $5\sqrt{3}$. The total area of the hexagon is

$$\frac{1}{2} \cdot \sqrt{3}(3^2 + 4^2 + 5^2)/2 + 18 = 25\sqrt{3}/2 + 18.$$

Since this is twice the area of the original triangle $2(\sqrt{3}x^2/4)$, we obtain

$$x = \sqrt{25 + 12\sqrt{3}}.$$

Also solved by John Jarvis, Raphael Justewicz, Monroe Kaufman, Peter McMeriamin, Avi Ornstein, William Katz, Norman Wickstrand, Henry Paynter, Harvey Kaufman, Winslow Hartford, Harry Zaremba, Melvin Garelick, Mary Lindenberg, Oliver Shih, Gerald Blum, Richard Beth, Michael Tersoff, Sidney Shapiro, Robert Kimble, Naomi Markovitz, Winthrop Leeds, Leon Bankoff, Irving Hopkins, Ken Zeger, Bruce Golden, Smith Turner, Richard Hess, Emmet Duffy, Jerome Shipman, Paul Mailhot, Robert Granetz, Frank Rubin, John Wrench, and Roger Powell.

FEB 3 There are nine suspects in a certain crime. When questioned, each answers as follows:

- John: "Elvis is guilty."
- George: "It was not Elvis."
- Ringo: "I did it."
- Paul: "It was either Ringo or Tommy."
- Elvis: "George isn't telling the truth."
- Fabian: "Ringo is guilty."
- Chubby: "It was not Ringo."
- Tommy: "It was neither Ringo nor I."
- Ricky: "Tommy is telling the truth, and it wasn't Elvis either."

Only three of these nine are telling the truth. That being so, who committed the crime?

I have appointed Shirley Wilson forewoman of the jury; here is the jury's verdict and Ms. Wilson's analysis:

The statements of John and George have opposite truth values, as do those of Ringo and Chubby and those of Paul and Tommy. The statements of Ringo and Fabian have the same truth values. Since there are exactly three true statements, which must be included in the three pairs of opposite valued statements, Elvis and Ricky are lying.

(1) Elvis lying \Rightarrow George is truthful \Rightarrow Elvis

is not guilty. Hence, John is lying and George is telling the truth.

(2) Ricky is lying \Rightarrow Tommy is lying \Rightarrow Paul is truthful. Hence, either Ringo or Tommy is guilty.

(3) Since there are only three true statements, Ringo and Fabian must both be lying.

(4) Ringo is lying \Rightarrow Chubby is truthful \Rightarrow Ringo is not guilty.

(5) Tommy is guilty.

Also solved by Raphael Justewicz, Scott Nason, Monroe Kaufman, Peter McMennamin, Avi Ornstein, L. Marden, William Katz, Jordan Wouk, Eric Rayboy, Harry Zaremba, Frank Carbin, Mary Lindenberg, Gerald Blum, Robert Kimble, Richard Marks, Ben Ackerman, Naomi Markovitz, Winthrop Leeds, Ken Zeger, Charles Rivers, Smith Turner, Richard Hess, Margaret Marcou, Brad Balfour, Ron Smirlock, Don Trumpler, James Shearer, Frank Rubin, R. Terry, and the proposer, Victor Sauer.

FEB 4 An interesting problem to try on scientific calculators is the generation of integers without the use of integer keys, the arithmetic operators (+, -, ×, ÷), or summation keys. For example, on an HP-45 one is excluded from using any of the bottom four rows of keys. Several problems can be posed:

- The number of different ways of generating a particular integer.
- The minimum number of keystrokes necessary to generate a particular integer. Two very intriguing ones are:
- The minimum number of keystrokes necessary to generate the numbers 1 through 10 (not necessarily in sequence).
- The largest integer of a sequence that starts from 1 that can be generated.

Three comments are necessary for clarification: obviously, solutions vary with the calculator used; on machines with dual function keys, use of a "gold" (or whatever) key and another key constitutes two keystrokes; and numbers must be generated such that the round-off capability of the machine is not used — i.e., the numbers must be integers within the total display capability of the machine.

First of all, Roger Powell sends us the following controversial solution for the HP-45: The solution of the shortest number of keystrokes necessary to produce the integers 1 through 10 is either three or five, depending on one's definition of keystroke. By pressing first RCL and then CHS, STO, and R↓ simultaneously the display will now show

00.00 00 00

indicating that one has successfully accessed the hidden "timer" on the 45 that was not made explicitly available until the 55. By now pressing CHS, the timer will begin to run and in due course will produce 01.00 00 00, albeit rather briefly, and then later 02.00 00 00, etc. The ambiguity in the number of keystrokes, then, is due to the possibility that three keys pressed at the same time constitute only

one logical keystroke. At any rate, even five will easily be the optimum solution.

Smith Turner's favorite is the TI-SR50:

```

1 e or I
2 e e x² 1n
3 E π x² x² x²
4 e e x² x² 1n
5 E π e x² x²
6 E π e 1/x x² x²
7 E π x² x² x² x²
8 e e x² x² x² 1n
9 E π log log x² x² x² x²
10 E π e x² x² x²

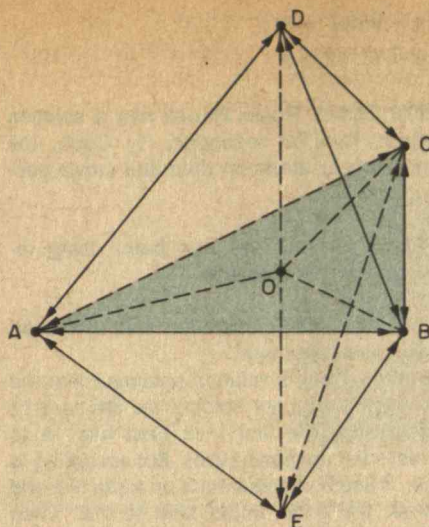
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Finally, Joe Sansone submitted the solution in the box at the bottom of this page for the HP-35. All solutions start from 0 (power on), except as noted. He describes this as a problem in learning how your particular model rounds off numbers and then learning how to get around it, i.e. getting 3, rather than 2.999999999. Evidently, he never did solve 7. By the way, getting 3, in 16 steps as shown above was the toughest of the bunch.

FEB 5 Consider n points on the surface of a sphere, free to move anywhere on the sphere's surface. The problem: if $n = 5$ and the points repel each other (that is, they assume positions that maximize the minimum distance between any two of the n points), where will the points go? For $n = 2$, they go to the ends of a diameter. For $n = 3$, they wind up on a great circle and form an equilateral triangle. For $n = 4$, the points move to the vertices of a tetrahedron. But what about $n = 5$?

We have two different arguments for believing the following 3-2 solution. Harry Zaremba's argument is physical in flavor whereas Avi Ornstein sends us a chemist's solution. We begin with Mr. Zaremba's diagram at the top of the next column:

Let the five points be designated by A through E. Three points, A, B, and C, will be the vertices of an equilateral triangle within a great circle, and the other two points D and E will be at the ends of a diameter perpendicular to the plane of the triangle at O. The repellent forces which will act on any point will be symmetrically disposed with respect to a radius of the sphere passing through the point, and will maintain the point in equilibrium. The direction of the resultant of these force components will coincide with that of the radius. The resultant force at D will equal the force at E, and the resultant at A will equal each of those at B and C. The



five points will form two identical pyramids having a common base ABC.

Mr. Ornstein's solution (he explains that he teaches honors chemistry and a course in pure mathematics) follows:

First, $n = 2$ has the same position as an sp hybrid bond, such as in CaCl_2 . When $n = 3$, the solution is the same as an sp^2 hybrid bond, such as in AlCl_3 . When $n = 4$, the solution is the tetrahedral structure of the sp^3 hybrid bond, such as CH_4 or CCl_4 . For $n = 5$, I believe the answer would be the combination of $n = 2$ and $n = 3$. Three of the points would be 120° apart from each other on the equator of the sphere, while an additional point would be at each of the poles, 90° from the equator. This matches an sp^3d hybrid bond, as in PCl_5 . The same positioning is also supported by some other bonding which includes filled orbitals. In XeCl_2 the chloride ions are at opposing poles while the filled orbitals are on the equator. Likewise, the filled orbitals are at the poles and the chloride ions are at the equator in ICl_3 .

Also solved by Raphael Justewicz, Eric Rayboy, Winslow Hartford, Harry Zaremba, Gerald Blum, Michael Tersoff, Irving Hopkins, Richard Hess, Jerome Shipman, and Rob Cave.

FEB SD 1 Three people, A, B, and C, are lined up so that A can see B and C, B can see C, and C can see no one. While A, B, and C are not looking, one of five hats, three black and two white, is placed on each of

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e ^x	ARC	ARC	ARC	ARC	start	ARC	start	ARC
	COS	COS	COS	COS	from 3	COS	from 3	COS
	TAN	TAN	TAN	TAN	e ^x	TAN	STO	TAN
	LOG	LOG	LOG	√x	STO	STO	e ^x	LOG
	LOG	LOG	STO	√x	R/	√x	RCL	√x
		STO	LOG	LOG	ARC	√x	x ⊖ y	
		1/x	RCL	√x	COS	√x	x ²	
		ARC	x ²		TAN	LOG	LN	
		SIN	LOG		LOG	1/x		
		TAN			LOG	RCL		
		RCL			RCL	x ²		
		x ⊖ y			x ²	LOG		
		x ²			LN	1/x		
		e ^x				1/x		
		LN						
		1/x						

their heads. A, B, and C are then asked what color each's hat is. A reports that he cannot determine this, and B gives the same answer. What is the color of C's hat?

As you know, solutions to speed problems are given at the end of the column in which the problem appears. But this time the given solution was incorrect, as Turner Gilman explains:

If A sees two white hats he knows that his is black. So B and C either both have black hats or one is black and one is white. Knowing this, if B sees a white hat he knows his is black. So C must have a *black* hat.

The error was also found by Elliot Roberts, Robert Logcher, Warren Dietz, Jerry Bozman, Raphael Justewicz, Shirley Wilson, Avi Ornstein, William Katz, L. Rosmussen, Parker Chapman, John Moulson, Jordan Wouk, Eric Rayboy, J. Friedman, Gerald Blum, Elmer Ingraham, Jeff Wisnia, Gregg Bemis, Leslie Toth, Paul Manooogan, David Mackapetris, Joel Ackerman, Hugo Mayer, James Shearer, R. Terry, and Robert Granetz.

Better Late Than Never

Y1978 Several readers found solutions which used 1, 9, 7, and 8 in order but required more operators than the published solution. This is not desired. There were, however, legitimate improvements found by Charles Rivers, Lou Cesa, and Clark Baker:

$$3 = 1 + (9 + 7)/8$$

$$28 = 8/(9/7 - 1)$$

$$89 = 1 * 97 - 8$$

1978 JAN 3 Roger Powell has a solution where, like the legendary Ty Cobb, the base-runner starts on third and steals second and first.

FEB 3 Jerry Griggs has been doing research on this problem.

J/J 1 Matthew Fountain has sent us the following improvement:

Matthew Chen's solution assumes that the probability of East holding the $\spadesuit K$ is 6/11 since after the first trick East has 12 to West's ten unknown cards. But according to this, if South played hearts on tricks two and three, the odds would shift to 1/2. Then West and East would both have ten unknown cards. Here is a somewhat similar case: I take 26 cards at random from a deck. Before I look at them I may persuade someone to wager at even money on whether or not I have a $\spadesuit K$. But would anyone offer me better odds if I exposed 25 of my cards after looking at them all? They would suspect my last card had 26 times as much chance of being the $\spadesuit K$ as any of the individual unknown cards still in the deck. I believe the correct probability for East holding the $\spadesuit K$ is 13/23, provided West is committed to always leading hearts when he has three hearts and North and South have the given holdings.

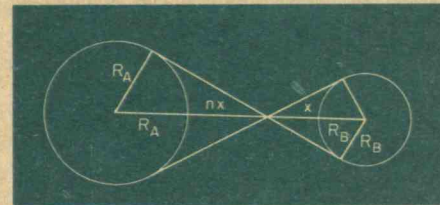
NOV 4 Craig Murphy has responded.

NOV 5 Tom Weil has found some "pseudowords" that have five consecutive letters.

D/J 3 Thomas Harriman has responded and Frank Rubin, the proposer, informs me that a sentence was omitted. The questioning was supposed to start with Adak. He is not sure that the "truncated problem" as published is solvable. Since a solution was given in the last issue there apparently is no trouble.

Proposers' Solutions to Speed Problems

SD 1 By similar triangles (see diagram), $RA/(RA + nx) = RB/(RB + x)$. Thus the radius of A is n times the radius of B.



SD 2 In the case of A the answer is 99.99+ per cent, since numbers with many digits are "bound" to have least one 3 and "essentially all" positive integers have "arbitrarily many" digits. In the second case the answer is 33 1/3 per cent, since in base three there is no digit 3.

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Dick Rasmusen Discusses Nuclear Safety



Calvin Campbell

YELLIN: I agree with Dick. Furthermore, if you set up an agency whose only job is to regulate nuclear power, you can't really expect it to do well when it compares the risks of non-nuclear and nuclear energy production.

MARCUS: We're not only concerned with risk, however, but also with benefit. And in electrical energy production, the population that receives the benefit is not the same population that suffers the risk. This is very clear with the recent incident in Pennsylvania. The people ready to evacuate, the people whose land might have been affected, are a small subgroup of those who get the rather diffuse benefit from the Three Mile Island plant.

RASMUSSEN: But that's true of every major industry in the United States. The steel is made in one place, and there they take the risks, and we get the benefit. The cars are made in one place; the oil is refined in one place. There's nothing unique about that in our society.

YELLIN: I think Norm has a point. The nuclear risks are spread out a lot more than you're intimating. Commercial reactor sites, as I've said before, are correlated with large populations. As a result, society as a whole effectively faces the associated risks.

RASMUSSEN: That's right. I think we figured 15 million people live within 25 miles of a nuclear power plant. But it's certainly true that the risk is somewhat higher the closer you are to the plant. But you don't get zero risk until you get out pretty far.

STEWART: You would lower the risk, but you might heighten the argument about the disparity between risk and benefit, if you have a nuclear park out someplace 300 miles away.

YELLIN: Yes, you could cut down the social risk by siting more remotely, but the three people who live near that distant reactor may get really mad.

(Laughter)

Near-Future Prospects

STEWART: I'm rather pessimistic about the lessons of Three Mile Island, in terms of how decisions will be

made, and who will make them, on nuclear power plants. I think we will make some improvements in training and regulation, but most of the action will be on the federal level. In a California case, for example, a decision was made against state regulation. The reasoning, in part, was that nuclear power is a comprehensive federal scheme and, in part, that there are national benefits from the development of nuclear power; and therefore we shouldn't allow a state with parochial interests to intervene. I'm not persuaded that the courts are going to shift as a result of the Three Mile Island incident.

MARCUS: Will there be a strong legislative reaction?

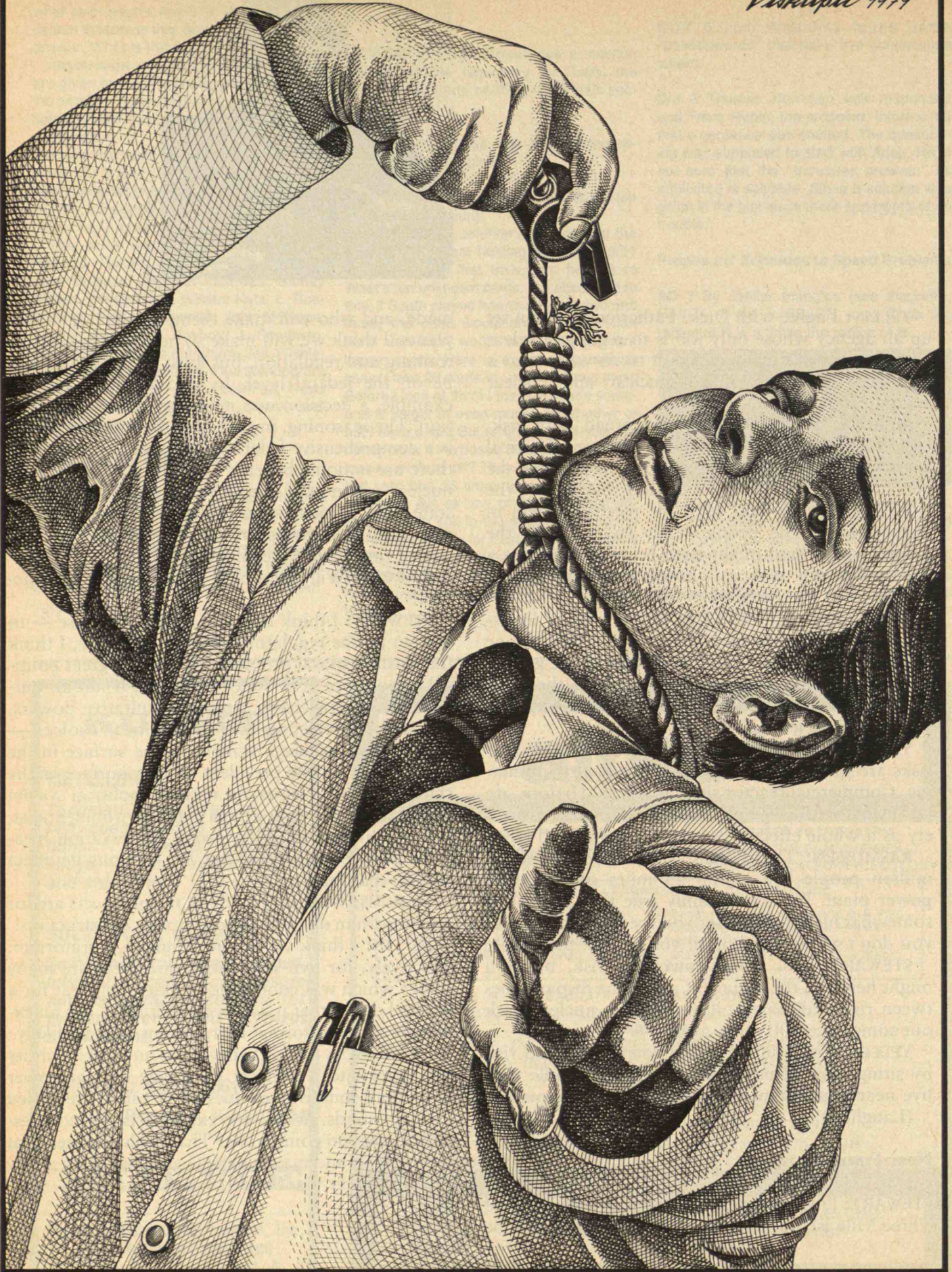
STEWART: I think that will be one response — to tighten up the regulatory posture. Secondly, I think the waste disposal problem will assume great political importance. The states will have, if not an outright veto, some fairly strong consultative powers. It's rather interesting that the political choices — which have not been brought to the surface in the Congress or by the president — may surface at the state level and re-enter the national political system that way. And of course, as a good environmentalist, I would like to see some strong conservation measures as a result of this. But I'm dubious its effect will go that far.

MARCUS: What do you think the prospects are for a moratorium on nuclear power plant construction?

YELLIN: I think we've had almost a moratorium, effectively, for two years now, and there are many things which will contribute to extending that for a while. I doubt that it will become formal, but an extension of the informal moratorium appears likely.

RASMUSSEN: I can't believe that any public utility will enter into a contract for a new nuclear power plant until some of the issues we've raised are settled in their minds. What, for example is the congressional reaction going to be? That probably means at least a year, and maybe more, before we'll see a new nuclear power plant order.

Viskupic 1979



Illustrations: Gary Viskupic

Due Process for Dissenting "Whistle-Blowers"

by Rosemary Chalk
and Frank von Hippel

On August 23, 1977, Glenn Greenwald, a chemist in the Public Utilities Department of the City of North Miami Beach, Fla., was called to 800 N.E. 182nd Terrace by a resident who complained that the water coming out of the tap tasted, smelled and looked peculiar. Mr. Greenwald agreed, and his tests showed that the water contained an abnormally small amount of free chlorine.

Laboratory analysis completed the next day revealed coliform bacteria in the water sample, and Greenwald decided that action was needed. Unable to find his supervisor, he asked his department head for an immediate flushing of the water distribution system in the area. Such flushings are accomplished by opening a neighborhood's fire hydrants, usually at night, but — trusting Mr. Greenwald's judgment — the department head ordered immediate action.

Mr. Greenwald's supervisor was irate when he learned of the flushing: he doubted that the action had been necessary; he feared that the residents of the affluent neighborhood where it had taken place might become unduly alarmed. He told Mr. Greenwald that he should consider resigning if he could not work through channels.

But the contamination problem had not been resolved by the flushing, and — in contrast to his superiors — Greenwald continued to believe that there was a potential health hazard. He wanted to continue tests and officially to advise residents of the house not to drink their tap water until further notice. His supervisors agreed to the continued testing but refused to authorize the official notice.

On the third day after Mr. Greenwald had first visited 800 N.E. 182nd Terrace, a teen-age resident asked him why the testing was still going on. Mr. Greenwald explained about the contamination problem, and he suggested that the family not drink

What may happen to scientists and engineers who "blow the whistle" on irresponsible employers?

the water until the problem had been cleared up. Later that same day, when the chemist told his supervisor and department head of this conversation, he was summarily discharged for insubordination.

Mr. Greenwald promptly took his case to the city's Civil Service Board, which three months later upheld his firing. Then he took his case to the U.S. Department of Labor, appealing under the employee protection section within the Safe Drinking Water Act of 1974. The relevant part of this legislation states that "No employer may discharge any employee or otherwise discriminate against any employee . . . because the employee has . . . participated . . . in any . . . action to carry out the purposes of this title." The Labor Department's administrative law judge who heard the case agreed that Mr. Greenwald's discharge was indeed a violation of the Safe Drinking Water Act; and the judge went on to observe that "to punish or discriminate against a chemist for recommending a procedure which, at worst, would be a precautionary step, would be to demand that all subordinates at all levels remain silent if so instructed until harm has occurred or is imminent." But Mr. Greenwald's was an empty victory. His complaint had not been filed within a 30-day statutory limit contained in the Act, so the judge recommended to the Secretary of Labor that the appeal be dismissed.

The Dilemma of the Employed Professional

Glenn Greenwald's experience in exercising his professional responsibility highlights a serious dilemma for modern scientists and engineers. Early assessments of adverse impacts of science and technology on society are often made by professionals

working within large organizations, but such organizations are usually eager to avoid what they describe as "premature" disclosure of concerns which may later prove to be insubstantial. Furthermore, such concerns typically involve value judgments as well as professional judgments, and this complicates their analysis.

The tension between an organization's concern to control its own affairs and the public's interest in knowing of possible hazards is mirrored in a tension of loyalties within its professional employees. Scientists and engineers are expected to be loyal to their organization's management, and they are so instructed by their professional societies; in its "Guidelines to Professional Employment for Engineers and Scientists," Engineers Joint Council writes that "the professional employee must be loyal to the employer's objectives and contribute his creativity to these goals." But as professionals — and in recognition of their special expertise — engineers and scientists are also given special responsibilities for the protection of the public. The "Engineer's Code" of the National Society for Professional Engineers states, for example, that "the engineer will have proper regard for the safety, health, and welfare of the public in the performance of his professional duties. If his engineering judgment is overruled by nontechnical authority, he will clearly point out the consequences. He will notify the proper authority of any observed conditions which endanger public safety and health. . . . He will regard his duty to the public welfare as paramount. . . ."

Ordinarily these expectations do not conflict. Occasionally, however, as in Mr. Greenwald's case, an issue cannot be resolved within organizational channels, and an employee is moved by feelings of professional responsibility to make sure that his concerns are heard by higher levels of management or responsible outside individuals. The employee is said to have "blown the whistle" when, without support or authority from his superiors, he independently makes known concerns to individuals outside the organization.

Though the public is clearly more receptive to criticism of large organizations now than it was 20 years ago, such "whistle blowing" remains an extreme and rather rare manifestation of the phenomenon of dissent. Many technical dissenters win an audience — and eventually a resolution of their concerns — within their organizations. And the vast majority of dissenters whose employers are unre-

sponsive either do not feel strongly enough about their dissents or are too timid to blow their whistles publicly. After finding that they are unable to obtain a full hearing for their concerns without antagonizing their supervisors, most dissenters decide to "swallow the whistle" rather than blow it. Unfortunately, most managements see dissenting employees as challenging the legitimacy of management's authority, and "whistle-blowing" is taken as a challenge to the credibility of the organization as a whole. Dissent therefore provides the ingredients for a confrontation between a technical expert and his management, and for most employees this is an intimidating prospect.

Yet, as the case of Glenn Greenwald shows, "whistle blowing" does in fact occur in the U.S. today, and no engineer or scientist can assume that he or she is immune to the pressures and dilemmas out of which it may arise. On the other hand, stories such as that on page 53 may be more common: in this case, the dissenting professionals, for a time at least, did not push their dissent to the point of confrontation because they did not want to lose their jobs. They therefore assented by their silence to a policy which violated their professional ethical standards.

As both these cases show, however, the dissenter is not the only one who has something at risk when dissent is ignored by management. Technical dissent is often an "early warning" signal of real problems that may escalate into serious issues for the enterprise if not dealt with early and effectively. We are all familiar with cases when safety-related automobile design defects have been left uncorrected and resulted in lawsuits by injured parties, in massive automobile recalls, and ultimately in adverse publicity.

The suppression of professional dissent can have another damaging effect on the organization, too: it can strain the loyalty and morale of employees who otherwise would care enough to do their jobs well and creatively.

Due Process for Dissent

For all these reasons, organizations and enterprises should develop due-process procedures for dealing with dissents and dissenters in a fair and responsive manner. Such procedures might, for example, include rights for dissenters to:

- ☐ Document and present concerns in writing to a qualified and balanced review group;

- ☐ Request that the review group hear others whose testimony is relevant, including those who will support the dissenters' position;
- ☐ See and respond to the counterpresentations by management; and
- ☐ Receive the review group's findings in writing within a reasonable length of time.

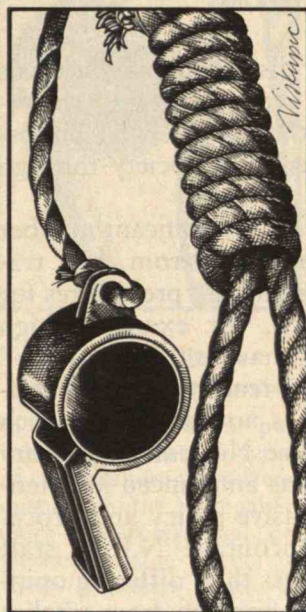
In addition to offering dissenters such due-process protections, these procedures would offer some protection to the employer, by:

- ☐ Requiring that employees express their concerns in writing, in detail;
- ☐ Assuring the organization of an independent evaluation of their significance; and
- ☐ Giving the organization a basis for defense against possible later accusations that it retaliated against dissenters when in fact only legitimate personnel actions had been taken.

Such due-process procedures could in some cases lead to the discharge, for reasons of insufficient competence, of a professional employee who had persistently raised issues mischievously or without reasonable grounds. It should not, however, be required that concerns raised by a dissenter be proved correct for his or her job to be protected. Many legitimate concerns about hazards to the public arise in areas where the basic technical data are missing or uncertain. Indeed, the initial difference of opinion may arise because a dissenter's predisposition is to delay a project until hazards can be more thoroughly understood — or determined to be small — while the employer is unwilling to change plans for less-than-proven hazards. The procedures should recognize that the dissenter may be performing an important service by drawing greater attention to a significant but previously neglected area of uncertainty, whether or not the dissenter's worst nightmares were ultimately confirmed.

In the absence of procedures and due-process protections, dissent is likely to develop into confrontation. Under these conditions unfounded and exaggerated accusations proliferate and the credibility, character, and motivations of both dissenters and organizations can become as controversial as the subject of the dissent itself, with the importance of the latter often lost.

As this kind of confrontation develops, management's leverage is often used to make the dissenter's employment situation quite unpleasant. The dissenter finds himself described as a "difficult person" — perhaps with ulterior motives — who is trying to impose exaggerated concerns on a conscientious



Protection for Dissenting Employees

The Committee on Scientific Freedom and Responsibility of the American Association for the Advancement of Science has identified eight public laws which include "employee protection" sections. These sections prohibit ad-

verse actions by employers against employees who assist in carrying out the regulatory purpose of the legislation, for instance by notifying responsible officials of legal violations or possible hazards regulated by the laws.

Employee protection sections are included in the following legislation:

- ☐ Occupational Safety and Health Act of 1979 (P.L. 91-596, Sec. 11c)
- ☐ Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500, Sec. 507)
- ☐ Safe Drinking Water Act of 1974 (P.L. 93-523, Sec. 1450)
- ☐ Toxic Substances Control Act of 1976 (P.L. 94-469, Sec. 23)
- ☐ Resource Conservation and Recovery Act of 1976 (P.L. 94-580, Sec. 7001)
- ☐ Clean Air Act Amendments of 1977 (P.L. 95-95, Sec. 312)
- ☐ Federal Mine Safety and Health Act of 1977 (P.L. 95-164, Sec. 105(c))
- ☐ Nuclear Regulatory Commission Authorization Act of 1978 (P.L. 95-601, Sec. 10)

management. While his defenders represent the dissenter as a dedicated individual acting as the conscience of an irresponsible organization, the dissenter himself, by overreacting, often damages his professional credibility. Indeed, technical dissents are often complicated by emotional actions and reactions which tend to mask and subvert the important technical issues which are at stake. As one congressional aide summarized his experience with management's treatment of dissenters in one agency, "First they drive them crazy. Then they tell us we shouldn't listen to them because they are crazy."

Thus extension of due-process protections to dissenters is important not only as a protection for human rights but also as a mechanism by which the credibility of the assertions by both sides can be tested. With due-process procedures, arguments are likely to be conducted more responsibly, and the record of the proceedings will provide a reasonable basis for public review of the technical issues.

Who Should Protect Dissenters?

Due-process protections for dissenting professionals can be established by a number of parties: by the organization which employs the dissenter, by professional colleagues, or by the larger society through laws and regulations.

It is encouraging to find that a significant number of managements are moving away from their traditional dependence on discretionary procedures for protecting dissent (in which, for example, high officials announce that they have an "open door" policy for dissenters) toward real due-process protections where the outcome is not kept under such tight management control. The Nuclear Regulatory Commission, for example, has announced its intention to develop a comprehensive policy and procedures that "would both encourage N.R.C. staff members to feel free to express their differing opinions and would assure their freedom from retaliation for having voiced a differing view."

Employees who feel that they are being retaliated against because of their dissent, however, are more likely to receive an efficient and impartial review by going to individuals or groups outside the organization's hierarchy. Depending upon the degree of independence which is required by the circumstances of the case, such a review could be undertaken by an ombudsman, a panel chosen by an arbitration procedure, or a special *ad hoc* review group established by an appropriate outside organization.

The value of having an outside group review the personnel issues growing out of professional disagreements between employees and management is exemplified by a case involving the Food and Drug Administration (F.D.A.). A number of F.D.A. medical professionals claimed in testimony before a Senate subcommittee that they had been improperly transferred after they had recommended against the licensing of particular drugs. In response to these accusations Alexander M. Schmidt, who was then F.D.A. Commissioner, conducted an internal investigation of the allegations and concluded that they were not supported by the facts. In the meantime, however, F.D.A.'s parent agency, the Department of Health, Education and Welfare, had responded to congressional pressure by establishing an external review panel to investigate the same complaints with the assistance of a legal staff. This staff documented beyond any reasonable doubt that the transfers, although they were made under a variety of other pretexts, had in fact generally been made because

the F.D.A. management felt that the professionals were displaying an attitude of "negativism" toward the drug industry. In response to these findings, a new F.D.A. commissioner issued letters of admonition to two bureau chiefs, reassigned one employee who had been improperly transferred, and apologized by letter on behalf of the agency to 12 employees and consultants who the panel said had been treated unfairly.

Professional societies are potentially a powerful source of support for scientists and engineers who dissent for ethical reasons, and indeed many societies have recently promulgated guidelines for the employment of professionals. These guidelines could represent a starting point for significant involvement. In the future, for example, professional societies could require that employment contracts for their members include provision for the resolution of employer-employee disputes through hearing and appeal processes; such provisions already exist in employment contracts covering unionized employees. Indeed, professional societies could persuade Congress that employment guidelines for professionals should be given legal force. This was proposed in 1976 by Alan C. Nixon, former president of the American Chemical Society.

Recently, the Institute of Electrical and Electronics Engineers has developed procedures for reviewing complaints by members about employers' retaliation for "professional responsibility" actions. In the first opinion issued under these procedures, the I.E.E.E. endorsed the action of a member who was dismissed for circulating a memorandum detailing her safety concerns after they had been ignored by her supervisors. But other professional societies, with the notable exception of the American Association of University Professors, have been strikingly reluctant to actively defend the professional independence of their employed members. This may reflect a lack of confidence in their probable effectiveness on the part of some societies. But in the case of many engineering and scientific societies, it probably also reflects the impact of an historical veto of their actions by influential high-level managers among their members who equate dissent with disloyalty. Thus the local chapter of the National Society of Professional Engineers which came to the defense of the dissenting BART engineers was subjected to heavy criticism from leadership groups in both its state and national parent organizations for its activities; some of the society elders argued that the chapter's actions reflected on the professionalism of the

engineer-managers who were in charge of the design and construction of BART.

As the public has become more aware and concerned about the suppression of employees' concerns about hazards or illegal actions, the courts and Congress have become more involved. Two arguments have been principally used to justify this new governmental intervention into the employee-management relationship which has been traditionally almost sacrosanct:

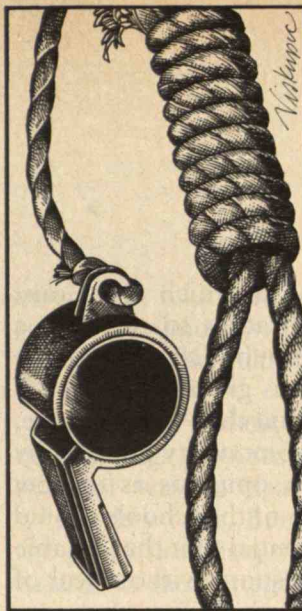
- In some cases retaliation against dissenting employees may infringe on their rights to freedom of speech; and
- The public interest requires protection for employees who are trying to bring their organizations into compliance with federal standards.

Civil Rights in the Workplace

David W. Ewing of Harvard Business School has argued that the current controversy over dissent and "whistle-blowing" within large organizations simply represents an extension into a new arena of the historical struggle over individual rights. Ewing has therefore discussed the problem of employee-employer relationships in terms of the need for a new bill of rights for employees. This analysis has considerable force — especially in connection with the need to protect employees' freedom of speech. Employees generally are experts in issues which arise in connection with their employment; if they cannot speak freely to their fellow citizens about what they know best, then their freedom is very limited indeed.

Until about ten years ago, however, the view that employees should have any rights beyond that of resigning in case of a professional disagreement received very little sympathy in the courts. The prevailing view was expressed by the oft-quoted opinion given in 1892 by Justice Oliver Wendell Holmes, then a member of the Massachusetts Supreme Court: "There are few employments for hire in which the servant does not agree to suspend his constitutional rights of free speech as well as idleness by the implied terms of his contract. The servant cannot complain, as he takes the employment on the terms which are offered him." (It is perhaps ironic that Justice Holmes later came to be venerated as "the great dissenter" on the U.S. Supreme Court.)

Almost a century later, however, the prevailing legal view of the employer-employee relationship has begun to change. Perhaps the most important sign of this change was the 1968 Pickering decision



Swallowing the Whistle: The Aircraft Brake Scandal

In 1972 James Olson published the results of a survey of 800 randomly selected members of the National Society of Professional Engineers: a large fraction of those engineers were sufficiently fearful of retaliation from their employers that they would "swallow the whistle" rather than become "whistle-blowers" if they found themselves confronting activities of their organizations which they considered contrary to the public interest. Almost half of the respondents indicated that they felt "restrained from criticizing their employer's activities or products," and over 10 per cent felt that they were "required to do things which violated their sense of right and wrong."

An example of a situation in which dissenters swallowed their ethical concerns at least temporarily is provided by the following case concerning the certification in 1968 of some new aircraft brakes at the B.F. Goodrich Wheel and Brake plant in Troy, Ohio.

In 1967 this plant won a subcontract to provide brake assemblies for the Air Force's new A7D light attack aircraft. Unfortunately, the brake assembly as initially designed turned out to be too light. When tested in simulated landings the brakes heated to such high temperatures that the linings burned

out before the design lifetime had been reached.

The young engineer in charge of testing the brake assemblies concluded that a heavier design was required. The project management, however, had already committed itself to delivering the lightweight brakes. Repeated attempts were therefore made to find lining materials which would tolerate the high temperatures.

When it finally became clear to all involved that a lining material with the necessary characteristics would not be found, time was running out; the project management, apparently unwilling to admit its misjudgments at such a late stage, decided to paper over the problem. Orders were given that the brakes be nursed through the qualification tests and that the documentation of the tests be fudged to conceal the irregularities. The engineers in charge of preparing the qualification reports protested; but, when offered the alternative of resigning their jobs, they decided to prepare the reports.

The brakes were duly delivered and installed in the A7D. But problems developed during the aircraft flight tests: the brakes locked during two landings, causing the plane to skid to a stop. This dramatic confirmation of their concerns finally overcame the hesitations of a junior engineer and a technical writer at the B.F. Goodrich plant, and both went to the F.B.I.

Subsequent investigations by both the Air Force and the General Accounting Office confirmed that the brakes had indeed been improperly qualified. In the meantime, Goodrich quickly developed a new set of brakes which passed the qualification tests and the two "whistle-blowers" found other jobs. □

of the U.S. Supreme Court, in which the Court ordered a local board of education to reinstate a teacher who had been fired for public criticism of the high priority that the board was giving to the funding of athletics. The Court found that "teachers are, as a class, the members of a community most likely to have informed and definite opinions as to how funds allotted to the operation of the schools should be spent. Accordingly, it is essential that they be able to speak out freely on such questions without fear of retaliatory dismissal."

The Court acknowledged that the need to protect the teacher's freedom of speech had to be balanced against the board's responsibility to preserve the effectiveness of the school; but in this case, it argued that the teacher's public statements had not interfered with the regular operations of the school nor had they called into question his fitness to teach.

Initially this protection of the freedom of speech applied only to public employees, since the Bill of Rights protects citizens only from government actions. More recently, however, the protection has been extended somewhat, to cover the employees of organizations which have a substantial "government involvement," taken to include ownership of facilities and/or purchase of most of the output of a contractor's plant.

Protecting the Public

In 1972 Ralph Nader remarked on the relatively small number of corporate employees who "go public" with their concerns about potential hazards caused by their company's activities: "Corporate employees are among the first to know about industrial dumping of mercury or fluoride sludge into waterways, defectively designed automobiles, or undisclosed adverse effects of prescription drugs and pesticides. They are the first to grasp the technical capabilities to prevent existing product or pollution hazards. But they are very often the last to speak out."

Congress also noticed this anomaly and therefore started some 10 years ago to include "employee protection sections" in federal safety and environmental laws. The sections are designed to protect from retaliation employees who bring to governmental attention hazards regulated under these laws. The protections include provision for a hearing before an outside examiner, and their administration is assigned to the Department of Labor. In general, however, the Department has not been aggressive in enforcing

the protections; it has even neglected to issue procedures or to notify employees of the existence of their protections. As a result, most employees are uninformed about these protections: Glenn Greenwald, for example, learned too late that in most cases employees are required to file their complaints within 30 days after an alleged retaliation occurs.

In areas not covered by employee protection legislation, the courts have occasionally intervened on behalf of employees who were dismissed by private organizations for attempting to uphold the law. Thus, for example, the West Virginia Supreme Court recently ruled in favor of a bank employee who complained of retaliation for trying to bring his employer into compliance with state consumer protection laws. The Court found that "the rule that an employer has an absolute right to discharge at will an employee must be tempered by the principle that, where the employer's motivation for the discharge is to contravene some substantial public policy principle, then the employer may be liable to the employee for damages occasioned by the discharge."

In the case of federal employees, Congress has recently concluded that "whistle-blowers" need special protection. The case which was most effective in convincing Congress of this fact was that involving A. Ernest Fitzgerald, a cost analyst (civilian employee) for the Air Force.

In brief, after Mr. Fitzgerald disclosed to a congressional committee a \$2 billion cost overrun on the C-5A air transport development contract, his civil service tenure was found to have been granted by a computer error (an extremely rare discovery); then Robert C. Seamans, who was then Secretary of the Air Force, abolished Mr. Fitzgerald's job as part of a "retrenchment program." Mr. Fitzgerald spent years in the courts and hundreds of thousands of dollars in legal expenses before he was finally reinstated.

In response to such cases, Congress included a section in the Civil Service Reform Act of 1978 barring reprisals by federal officials against employees who disclose information "concerning the existence of any activity which the employee . . . reasonably believes constitutes . . . mismanagement . . . or a substantial and specific danger to the public health or safety."

Of course, no amount of due-process protection will protect dissenters who have become *persona non grata* in their organizations from subtle harassment. For such circumstances, in which work situations are made demoralizing by managements

who want to be rid of employees but do not retaliate against them openly, additional remedies must be sought. One possibility suggested to us is a placement service that would give a high priority to placing conscientious dissenters whose employment situations have become untenable; such services could be operated by professional societies.

Dealing With The Issues

Whatever due-process protections to dissenting professional employees are provided will have little value unless they are imbedded in a process which deals effectively with the *substance* of the dissent. Those who would develop due-process procedures for dissenters must keep in mind the necessity for providing open and balanced reviews of the issues being raised. Too often review groups present unsubstantiated conclusions which cast doubt on the integrity of the review process and become the focus of new controversy.

Fortunately, to some extent the protection of conscientious dissent will facilitate the development of impartial reviews: if a dissenter cannot be silenced, it becomes more difficult to ignore his concerns. Of course, not all disputes can be resolved within an organization, no matter how good its procedures. Inevitably, some issues will ultimately be debated in the public arena. Here we find a great deal of misapprehension among professionals: What actually happens when a technical issue is taken to the public? Is there in fact a sort of Gresham's law in the undisciplined area of public debate, according to which bad science drives out good?

There is unfortunately some basis for such concerns. But we are convinced that the questions reflect an oversimplified view of the process of public policymaking.

The fact is that very few technical issues are decided directly by the public. We do not mean to be cynical: concerned advocates or opponents of a particular technical development take their cases to the public at least in part because that is the most effective way to gain the attention of high-level policymakers. That accomplished, the policymakers often respond by establishing a credible review process to recapture control over policymaking. If the fairness of the review process is accepted by other political actors and if the validity and appropriateness of the technical input is generally accepted by the technical community, the legitimacy of the final decision will also be accepted. From this perspective, it is fair to

assert that taking an issue to the public in the long run tends almost without exception to raise, rather than lower, the quality of the policymaking process for technology.

In summary, then, silencing dissenters as bearers of ill-tidings may seem in the short term to be the simplest way to deal with the difficult problems which they raise. But in the longer term enhancing the professionalism of scientists and engineers, and defense of their integrity when following its dictates, are vital to the welfare of our entire society.

Further Readings

Civil Liberties Review, special issue of September/October, 1978 (Vol. 5, No. 3).

Committee on Social Implications of Technology, I.E.E.E., *Newsletter on Technology and Society*, No. 22. New York: Institute of Electrical and Electronics Engineers.

Edsall, John T., *Scientific Freedom and Responsibility*, a report of the Committee on Scientific Freedom and Responsibility. Washington, D.C.: American Association for the Advancement of Science, 1975. (The report was summarized in *Science* for May 16, 1975, pp. 687-693.)

Engineers Joint Council, *Guidelines to Professional Employment for Engineers and Scientists*. New York: E.J.C., August 1, 1978.

Ewing, David W., *Freedom Inside the Organization: Bringing Civil Liberties to the Workplace*. New York: Dutton, 1977.

— "What Business Thinks About Employee Rights," *Harvard Business Review*, September-October, 1977, p. 81.

Ibsen, Henrik, *An Enemy of the People* (1882). New York: Penguin Books, 1977.

Layton, Edwin, T., Jr., *The Revolt of the Engineers: Social Responsibility and the American Engineering Profession*. Cleveland: Case Western Reserve University Press, 1971.

Nader, Ralph, Peter Petkas, and Kate Blackwell, eds., *Whistle-Blowing*. New York: Grossman, 1972.

Nixon, Alan C., "Legalization of Employment Guidelines," in *Legal Rights of Chemists and Engineers*. Washington, D.C.: American Chemical Society, 1977 (Advances in Chemistry Series No. 161).

Olson, J., "Engineer Attitudes Toward Professionalism, Employment, and Social Responsibility," *Professional Engineer*, August, 1972, p. 30.

Primack, Joel, and Frank von Hippel, *Advice and Dissent: Scientists in the Political Arena*. New York: Basic Books, 1974, and New American Library, 1976.

Proceedings of the Conference on Engineering Ethics, May 18-19, 1975. New York: American Society of Civil Engineers, 1976.

Review Panel on New Drug Regulation, *Investigation of Allegations Relating to the Bureau of Drugs, Food and Drug Administration*. Washington, D.C.: Department of Health, Education and Welfare, 1977.

Senate Committee on Governmental Affairs, *The Whistleblowers*, Washington, D.C., Government Printing Office, 1978.

Subcommittee on Economy in Government (Joint Economic Committee), *Air Force A7D Brake Problem* (record of hearings on August 13, 1969). Washington, D.C.: Government Printing Office, 1969.

— *The Dismissal of A. Ernest Fitzgerald by the Department of Defense* (record of hearings on November 17 and 18, 1969). Washington, D.C.: Government Printing Office, 1969.

Rosemary Chalk is a science policy analyst; she is staff officer for the Committee on Scientific Freedom and Responsibility at the American Association for the Advancement of Science. Frank von Hippel, senior research physicist at Princeton University's Center for Energy and Environmental Studies, is a founding member of the Committee, which was established by A.A.A.S. in 1976 to encourage the development of policies and procedures to protect scientists and engineers against infringements of scientific freedom and responsibility.

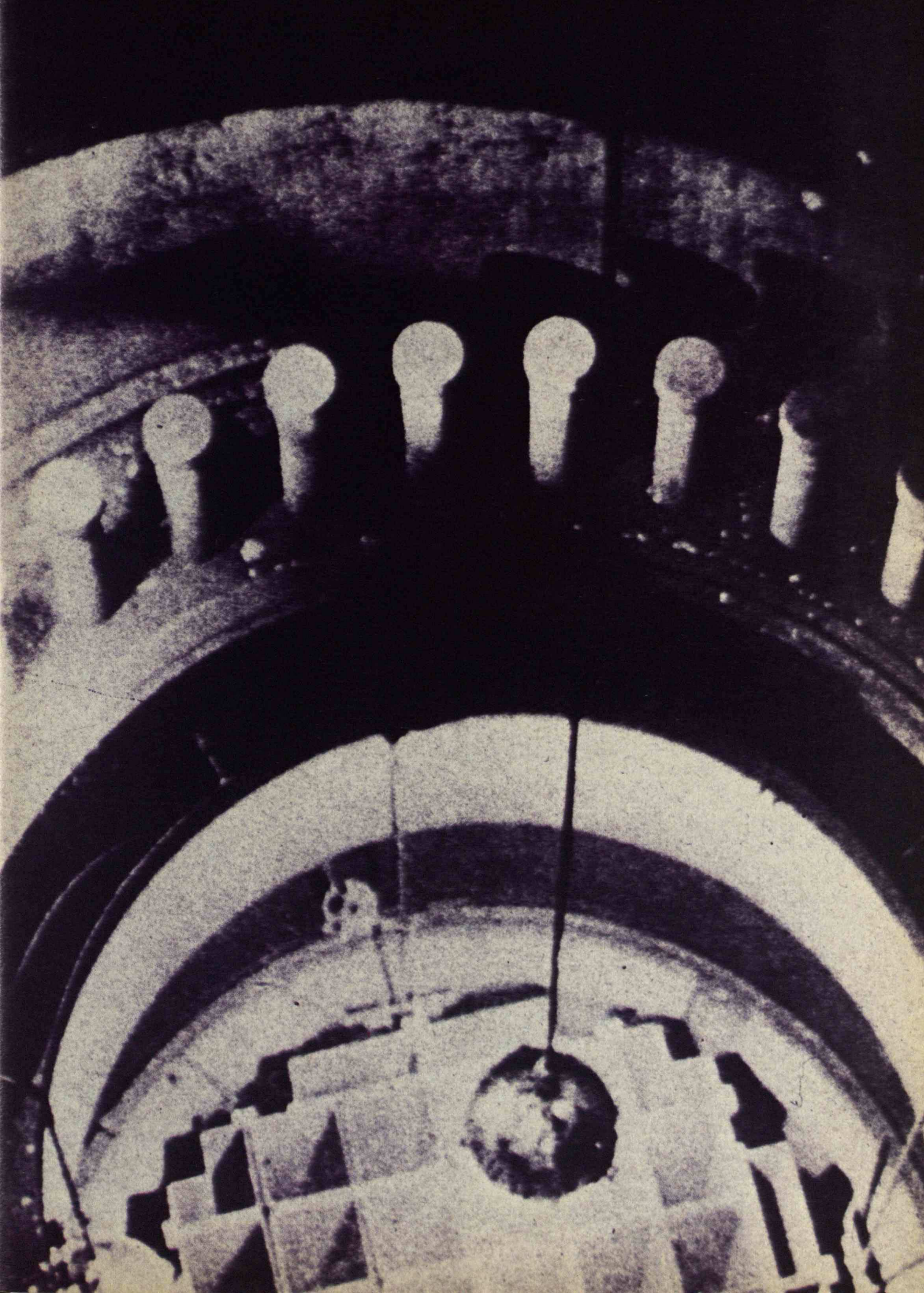
Nuclear power plants do not last forever. In the United States some large commercial reactors are scheduled for decommissioning within the next 20 years and many others will follow. But the process and its costs are still subject to uncertainties.

Decommissioning Commercial Nuclear Reactors

by Joseph A. Sefcik

For a number of reasons it has been considered attractive to operate commercial nuclear power plants for about 30 to 40 years. At that point they will be retired, or decommissioned, a process that will present particularly challenging problems. Technical problems of demolition and removal will be compounded by the presence of radioactivity. The economics of the process are complicated by the time required for radioactive decay to take place, and by the need to distribute costs equitably among consumers who will already have received and paid for the benefits of the plant in the form of electricity. Above all, decommissioning plans will have to satisfy requirements for public safety, so that they will be subject to intensive governmental control and public scrutiny.

View into the Elk River Nuclear Reactor, Elk River, Minn., prior to its dismantlement. The reactor was completely torn down by the Atomic Energy Commission in 1973 and decommissioned in November, 1974, at a cost of about \$6.5 million. (Photo: United Nuclear Corp.)



Why Decommissioning Is Necessary

The operating lifetime of current light water nuclear reactor plants is limited practically by the outcome of basic cost-benefit economic analysis. The more conventional parts of the plant — turbines, bearings, valves, pumps, pipes and the like — are subject to wear, fatigue, and eventual failure. In the case of nuclear power plants, the replacement of such parts may be necessary to maintain compliance with the guidelines for safe operation found in the codes of the American Society of Mechanical Engineers (A.S.M.E.).

Often various “backfits” are made to keep a plant in compliance with new, tightened standards. If a large component must be replaced — for example, a steam generator in a pressurized water reactor — a power plant may be shut down for six months to a year, incurring serious loss of revenues in addition to costs of the replacement parts and installation efforts.

Utility executives, faced with an expensive plant overhaul, have the difficult task of deciding whether to fix or replace the old plant. Their choice is somewhat analogous to that made by an automobile owner when deciding whether to replace a major component like an engine or to buy a new car: it may be more cost-effective to build a new plant than to continue and refurbish an old one.

Because of changes in the financial climate, many steam plants built in the 1930's and 1940's have been shut down and replaced with coal and nuclear power plants of greater capacities. Thirty years from now capital replacement costs may become so high that it may be attractive to keep these plants operating as long as possible. As an extension of the automobile analogy, consider the fact that the replacement cost of motor vehicles has increased so markedly that many people are keeping older vehicles longer than was customary during better times. But just as the older car may no longer serve its primary purpose — determined by the owner's needs — individual nuclear power plants must be analyzed carefully to determine their worth under prevailing economic conditions.

Embrittlement and Aging

One of the most important components of the nuclear plant is the reactor pressure vessel, which houses the radioactive reactor core. The pressure vessel must be able to withstand safely the many re-



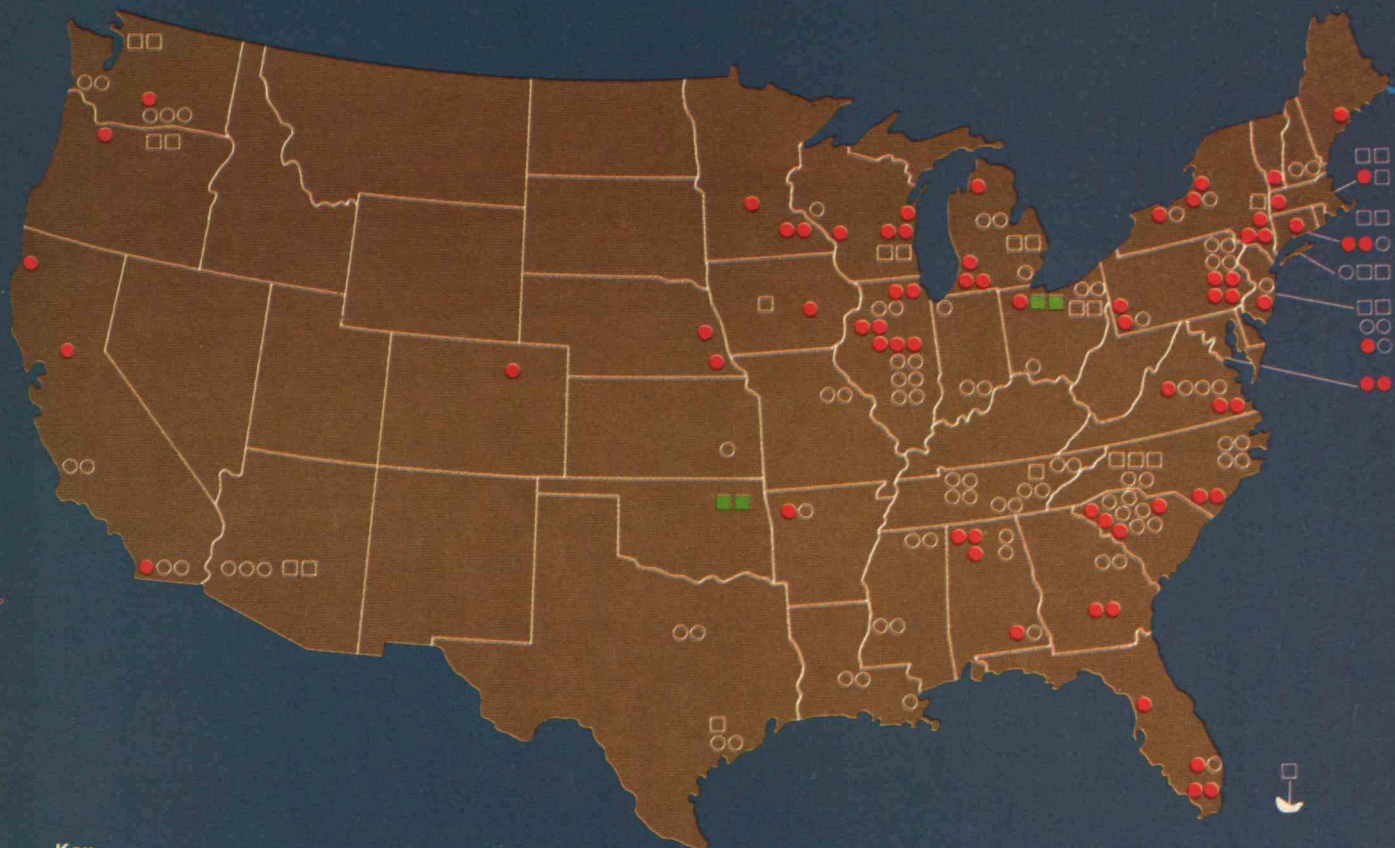
Above: The containment dome of the Elk River Reactor, partially razed by the wrecker's ball (Photo: United Power Association).

Map at right: As of November 30, 1978, 72 commercial power reactors held operating licenses granted by the Nuclear Regulatory Commission, representing a total electrical capacity of 52,273 MW. An additional 90 reactors have been issued construction permits; four more have limited work authorizations, and 37 are on order (several of which are not sited on the map), embodying a potential electrical capacity of 145,645 MW. (Data: Atomic Industrial Forum, Inc.)

peated cycles of temperature and pressure to which it is subjected. In pressurized water reactors (and in some early boiling water reactor designs) the high neutron fluxes encountered in the belt-line region of the steel pressure vessel leads to its progressive embrittlement and susceptibility to failure. To understand this fundamental phenomenon, which limits the useful life of the reactor pressure vessel, one must understand something of a reactor's construction and operation.

The core of a light water reactor is designed to use as many neutrons as possible in order to maintain what physicists call a good “neutron economy.” Nevertheless, some neutrons do escape and impinge on the steel reactor pressure vessel. Depending on their relative energy, these neutrons may affect the structure of the steel profoundly — or hardly at all.

A low energy neutron that strikes an atom of the vessel metal generally will not do much more than increase the vibrational energy of the affected atom or convert it to another isotope. However, neutrons with energies greater than about one million elec-



Key

- Reactor with operating license
- Reactor under construction
- Reactor with limited work authorization
- Site of reactor on order

tron volts can knock an atom out of its site in the three-dimensional structure, or crystal lattice, of the steel. An atom thus struck by a fast neutron is dubbed a "primary knock-on atom" or PKA. The PKA proceeds to bump other atoms, setting up a cascade of displaced atoms. (Other, more complicated processes can occur but they are deleted here for simplicity.)

As additional atoms join the cascade, their former sites become vacancies in the zone of the lattice where the PKA was produced. These newly itinerant atoms eventually come to rest somewhere between other occupied atomic sites in the lattice. When close to each other, vacancies and interstitial atoms combine and "anneal" out. However, many regions or "cores" of nonannealed vacancies remain. As a result, the steel's plasticity is reduced and the transition between brittle and ductile behavior will occur at higher temperatures. We say that such a steel has been embrittled.

The rate of embrittlement depends on the energy of the impinging neutrons, the composition of the alloy, the direction of the atomic cascade, the temperature during irradiation, and other factors; its estimation is a task subject to uncertainty. To ensure the safety of the pressure vessel, reactor operators employ pragmatic measures — they irradiate in the core samples of the steel from the original batch used to fabricate the vessel. Periodically these samples are removed and subjected to impact testing procedures. Over a period of time such tests provide a picture of how the strength of the pressure vessel material changes with continued neutron bombardment.

The decline of metal toughness dictates the use of an appropriate safety margin in the projected lifetime of a reactor. These safety factors are currently very conservative, but sometimes they must be inflated when tests of pressure vessel samples reveal unexpected factors that can profoundly shorten projected lifetimes. For example, it has been found that copper impurities in the steel significantly enhance the embrittlement process. Thus, the pressure vessels of operating pressurized water reactors that contain copper impurities may be forced into an earlier retirement than originally had been planned.

The outright replacement of a reactor pressure vessel is likely to be financially prohibitive under most economic conditions in present power reactor designs, although some speculative plans regarding the in situ annealing of the vessel have been suggested. At temperatures greater than about one-

third the melting temperature of the metal, vacancies and interstitials "anneal out" and the damage is repaired. The possibility of shutting down the reactor and using electric heaters to repair the neutron damage presents an interesting technical promise — and challenge. Indeed, a small test reactor, the SM-1A was annealed in 1967 using nuclear heating; approximately 61 per cent of the radiation damage was successfully repaired.

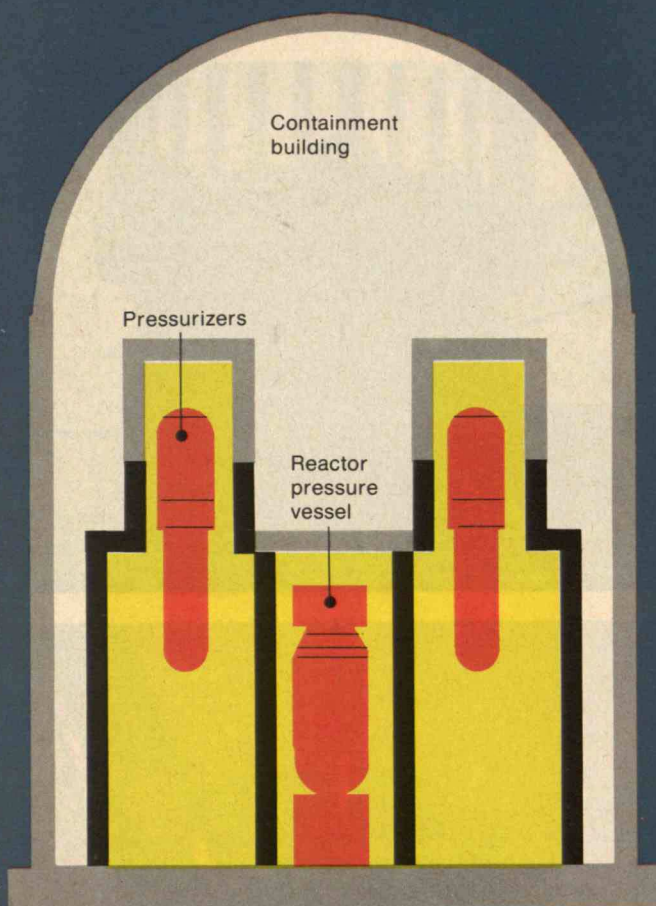
Current Decommissioning Strategies

The N.R.C. issues reactor operating licenses for a specific number of years, which may vary from plant to plant, reserving the right and power to terminate a license before its expiration — for example, if a plant cannot be operated safely. When a license expires the plant owner can either decommission the plant or apply for license renewal, subject to N.R.C. guidelines. Indeed, economic factors may influence the utility to withdraw the reactor from service prior to any regulatory considerations. Requirements for decommissioning are set down in Title 10, Part 50 of the Code of Federal Regulations (10 C.F.R. 50). These regulations require that the operator of the reactor restore the reactor site to a condition deemed acceptably safe by the N.R.C. and, further, that the act of site restoration must not jeopardize public safety.

Four means of dealing with the reactor itself have been accepted by the N.R.C., and are described in the N.R.C. *Regulatory Guide 1.86* of June, 1974:

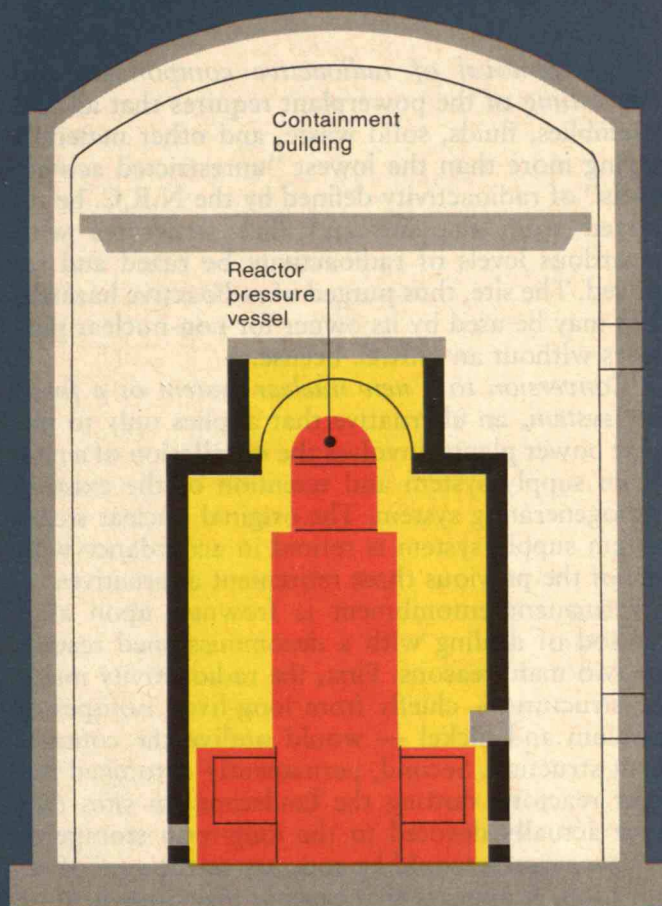
□ *Mothballing* of a nuclear powerplant consists of putting the facility under guard and in a state of storage. All fuel assemblies, radioactive fluids, and radioactive wastes must be removed from the site. Remnant radiation must be carefully monitored both inside and outside the plant, to insure public safety.

□ *In-place entombment* consists of the removal of all fuel assemblies, radioactive fluids, wastes, and certain selected components from the site and then sealing all the remaining radioactive or contaminated components — the pressure vessel and reactor internals — within the reinforced concrete biological shielding structure. This sealed structure must survive long enough to permit the radioactivity to drop to levels deemed acceptable by the N.R.C. Surveillance of the entombed powerplant must continue at the cost of the owner under a license that permits only possession (as opposed to utilization) of the site and the radioactive materials in the structure.



Pressurized water reactor entombment boundary

■ Original structure
 ■ Constructed for entombment



Boiling water reactor entombment boundary

■ Original structure
 ■ Constructed for entombment

Entombment of pressurized water reactors and boiling water reactors will require the permanent addition of steel barriers in place of once-removable access provisions and the sealing of holes through which coolant pipes had run.

□ *The removal of radioactive components and dismantling of the powerplant* requires that all fuel assemblies, fluids, solid waste, and other materials having more than the lowest “unrestricted activity levels” of radioactivity defined by the N.R.C. be removed from the site and that structures with hazardous levels of radioactivity be razed and removed. The site, thus purged of radioactive hazards, then may be used by its owner for non-nuclear purposes without an N.R.C. license.

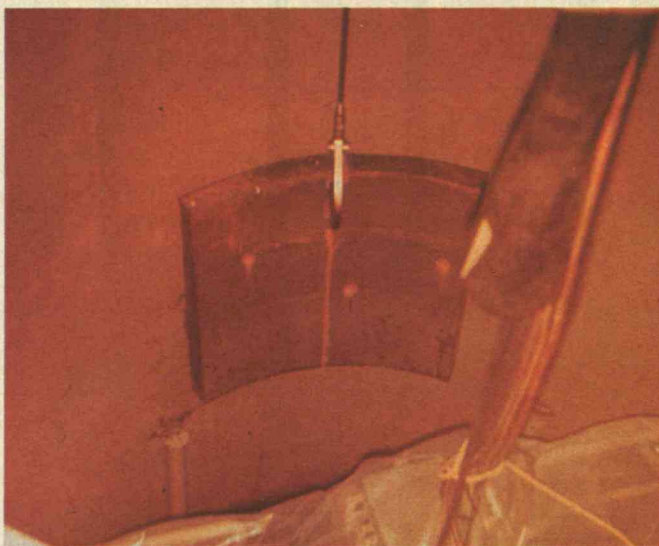
□ *Conversion to a new nuclear system or a fossil fuel system*, an alternative that applies only to nuclear power plants, involves the installation of a new steam supply system and retention of the existing turbogenerating system. The original nuclear steam system supply system is retired in accordance with one of the previous three retirement alternatives.

Permanent entombment is frowned upon as a method of dealing with a decommissioned reactor for two main reasons. First, the radioactivity inside the structure — chiefly from long-lived isotopes of niobium and nickel — would outlive the containment structure. Second, permanently entombed nuclear reactors, dotting the landscape on sites that were actually devoted to the long-term storage of nuclear wastes, would be contrary to the goal of restoration. It appears that prompt dismantlement or mothballing with delayed dismantlement are the only realistic decommissioning options in the foreseeable future.

A practical consideration: engineers in 40 or 50 years may find our present-day nonstandardized reactor designs unfamiliar and exceedingly tedious to dismantle safely. On the other hand, advances in technology and a “learning curve” of decommissioning experience may make the operation even more straightforward than assumed. From this standpoint prompt dismantlement appears to offer the least technical and economic uncertainty, even though it is the most costly decommissioning option.

Removing the Radioactivity

All current variants of decommissioning require that radioactive materials be removed from the reactor. After the reactor is shut down, the fuel is removed to the storage pool to cool for about 150 days. Then fuel and any other radioactive materials in the plant’s temporary holding tanks are removed from the site and transported to a waste processing facility. These materials contain most of the radioactivity in the plant.



The upper six-foot section of the Elk River Reactor pressure vessel, which was removed in one piece. (Photo: United Nuclear Corp.)

A segment of the Elk River Reactor pressure vessel being lifted from within the vessel during the process of dissection with the remotely operated plasma arc torch. (Photo: United Nuclear Corp.)

Technicians lifting an encased section of mildly radioactive steel liner from a storage pool at the Elk River Reactor. (Photo: Nuclear Energy Services, Inc.)

The reactor coolant is then drained, an operation that presents some unique problems. Reactors are sometimes operated with some failed fuel elements in place; these release radioactive contaminants — fission products and debris from ruptured fuel elements — into the reactor coolant. In addition, impurities already in the coolant (such as corrosion products) will be activated by neutron bombardment. To deal with these hazards, after the coolant is removed from the reactor, it is evaporated, leaving the radioactive materials behind as a sludge. The sludge is then packaged and transported from the site to a waste disposal facility.

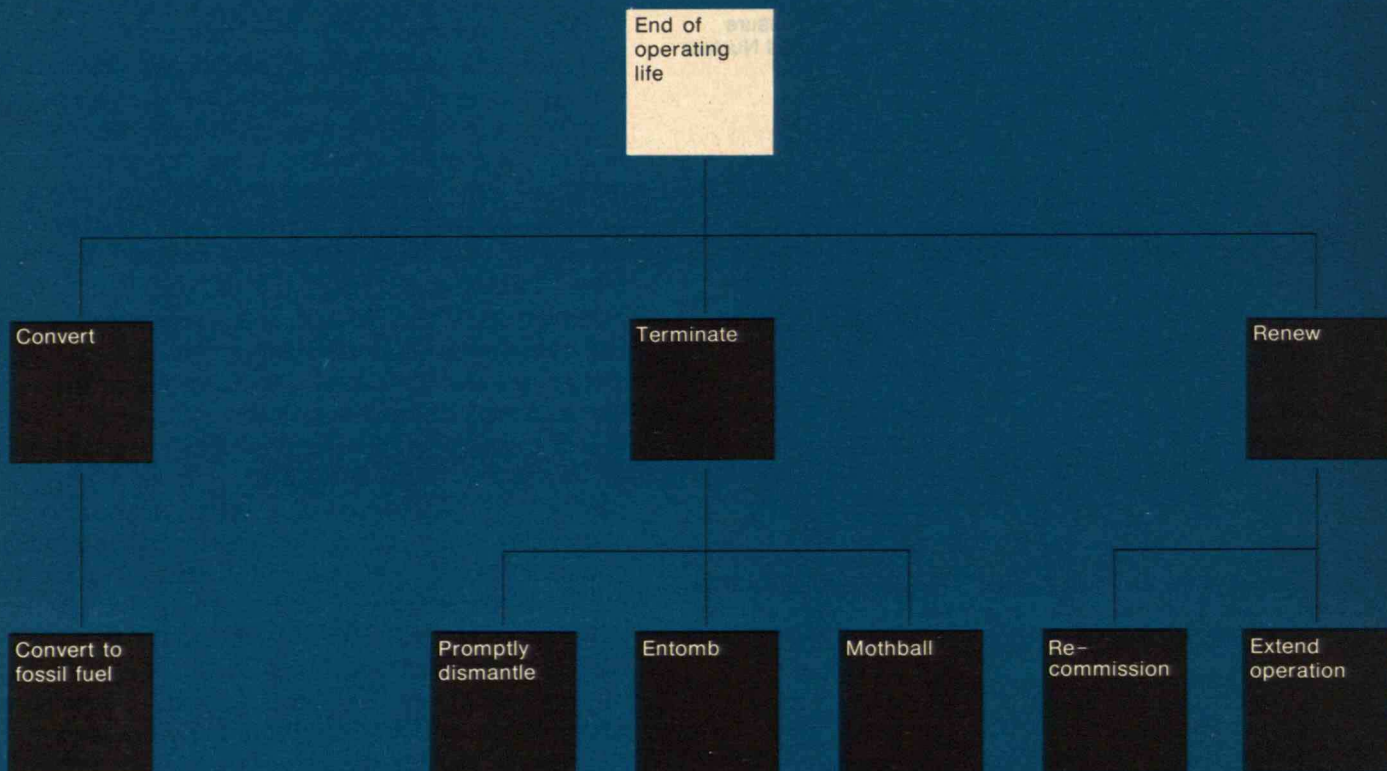
If the reactor is to be dismantled, the pressure vessel must be decontaminated, cut into shippable pieces, and transported to a waste disposal repository. Prior to dissection, the vessel walls and internal components are cleansed of debris and scale to minimize the release of radioactivity via vaporized contaminants produced by the cutting torch. At present, repeated washings with hot acidic and alkaline solutions are used for the cleanup, but further development of remote handling technology may make feasible the use of ultrasonic cleaners or electro-polishing for the big job of decontaminating large reactor pressure vessels.

The cleaning process generates additional liquid waste, which must be safely stored and then disposed of in a safe manner. To facilitate disposal, the volume of these highly radioactive, spent cleaning fluids is reduced chemically on site. The resulting contaminated sludge is then transported in tightly sealed, shielded containers to an approved disposal site. Some of the final rinses may be so slightly radioactive that they can be released directly to the environment safely.

Radioactive Hazards in the Retired Plant

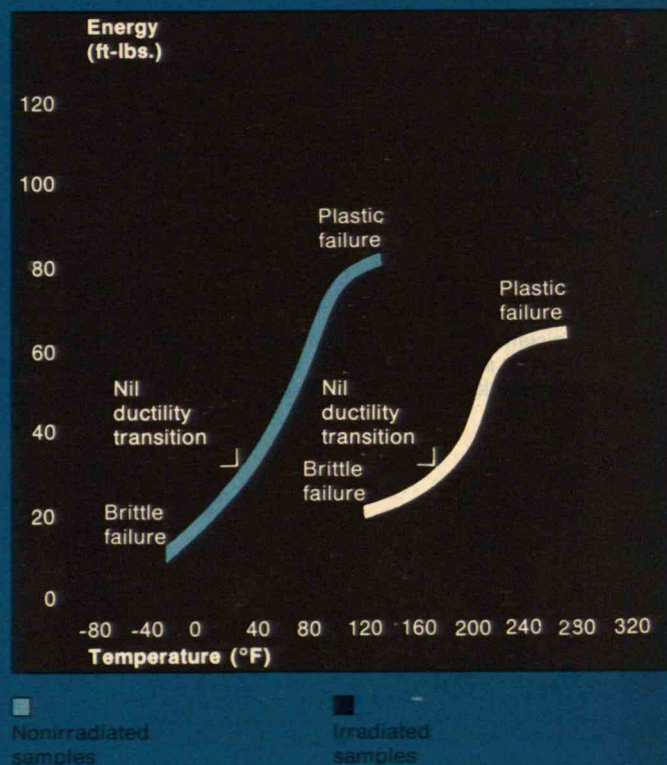
During normal operation, some neutrons impinging on the structural material in the reactor become absorbed into the nuclei of constituent atoms. Such absorption produces radioactive isotopes of the elements within the structure itself.

Isotopes develop in this fashion in the major components of every fission reactor — the pressure vessel, the upper and lower core supports, the core barrel, and the shroud. These major components are made of carbon steel, stainless steel, other nickel-steel alloys, and Zircaloy. The radioactive isotope of principal concern is cobalt-60, which has a half-life of 5.2 years. This isotope is responsible for most of



Above: The chart shows the options available at the end of a reactor's operating life, a point determined by conditions described on the N.R.C. Operating License granted to the reactor operator. As shown, a reactor need not be necessarily decommissioned when the original license expires; conversely, the lifetime cited in the original license may be shortened under some circumstances.

Right: These graphed functions represent the reactions of samples of A302-B steel alloy to a range of sudden impacts in standard Charpy-V notch impact tests over a range of temperatures. The steel plates represented by the line to the right were irradiated with about 3×10^{19} neutrons per square centimeter, each neutron having a potential energy of greater than one megavolt, at 550°F, conditions akin to those inside the pressure vessel of an operating nuclear reactor. Note that the irradiated sample fractures in a brittle manner at 120°F from a relatively light impact of 20 foot-pounds; at the same temperature a nonirradiated sample, after sustaining an impact of 80 foot-pounds, fails in a plastic manner. (Data: L. E. Steele)



the radioactive dose expected during dismantling. Cobalt-60 in the quantities expected is much less dangerous after 50 years, because radioactivity levels then are about 0.1 per cent of those measured immediately after plant shutdown. Thus, substantial benefits both in the lower costs of the thinner shielding required and in employee safety can be gained by allowing the vessel to "cool down" after the plant is shut down.

Nickel-59 will also be present, but should produce relatively low doses of radioactivity. However, its 80,000-year half-life is so long that the technique for dealing with this isotope will probably determine the waste disposal strategy to be used for most "hot" metal components.

As the pressure vessel is cut into small pieces, some radioactive particulates are put into the air. In order to reduce the amount of dust generated, some cutting can be done under water with remote manipulators; blasting dust can be minimized by the use of shaped charges. Moreover, if dismantling is performed within the sealed containment building, off-site exposure can be controlled by carefully filtering the air vented to the atmosphere. Once the radioactive components have been removed, the containment building can be removed routinely.

Reactor Decommissioning Experiences

Several small nuclear reactors have been retired to the various degrees described earlier. Since all of these reactors would be dwarfed by present-day commercial reactors, the direct scaling of experiences may be misleading. Nevertheless, experience gained from these decommissioning episodes is the only background available, and it is helpful in assessing the costs and risks associated with retiring larger facilities.

□ Among the mothballed reactors is the Carolinas-Virginia Tube Reactor in Parr, S.C. This reactor, cooled and moderated with heavy water, produced 17 megawatts of electrical output (MW[e]), and was operated by a private utility with Atomic Energy Commission (A.E.C.) backing for four years. Upon retirement of this reactor, the nuclear fuel and the deuterium oxide were shipped from the site, core components were sealed in the moderator vault, and access hatches were welded shut. The reactor is still subject to periodic surveillance and utilization of the facility is not permitted. It is currently licensed by the N.R.C. under the terms of 10 C.F.R. 30, which permits the owner to possess

radioactive byproduct material, namely, the activation products in the plant's structural materials.

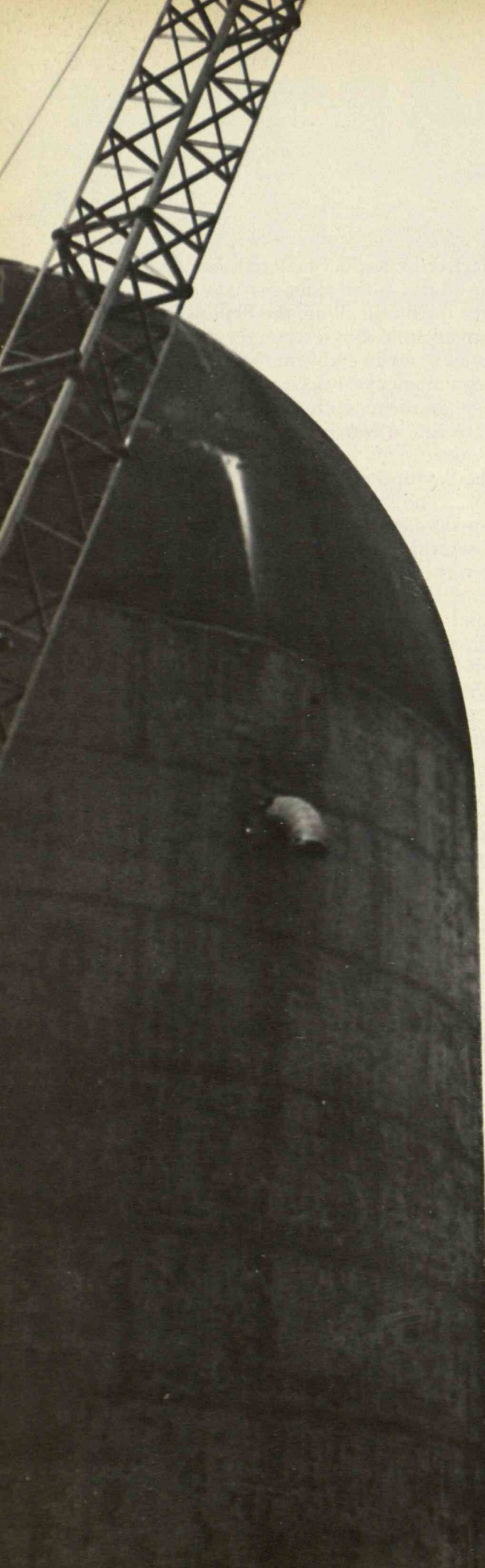
After the mothballing, the Phillips Petroleum Co. performed numerous tests on the containment under the terms of an amendment to the byproduct license. The containment's response to seismicity, rates of leakage, and reaction to a simulated accident in the (then) A.E.C.'s water reactor safety program were investigated.

□ The Saxton Pressurized Water Reactor (PWR) in Saxton, Penn., also underwent only minimal decommissioning. Used for research and development purposes, this 10 MW(e) reactor was the test bed for numerous innovations, including Zircaloy-clad fuel elements, Boron-Shim reactivity control, clustered grouping of control rods, and the use of plutonium fuel in commercial reactors. The retirement plan chosen for the Saxton PWR involves a 50-year mothballing period, with an annual cost for quarterly surveillance of \$9,600 (1973). After 50 years it is estimated that the radioactivity of the highly activated core components will have decayed away to barely significant levels, and reactor core components can be removed for a cost of \$575,000 (1973), including surveillance, compared with \$1.62 million for prompt removal and dismantling.

Topography at the site of the Saxton Reactor dictated an additional step in the retirement strategy — the plant was only 1.5 feet above the level of the highest flood on record for the location. To prevent the possibility of a spread of radioactivity in the event of an even higher flood, all storage tanks outside the containment were dug up and removed.

□ The decision by the Philadelphia Electric Co. to decommission in 1974 the 40 MW(e) Peach Bottom High Temperature Gas Reactor (HTGR) in Peach Bottom, Penn., was based on the high costs of backfits needed to meet tightened safety criteria. The reactor will be mothballed for 50 years, when the maximum dose rates from cobalt-60 and iron-55 at the surface of the reactor vessel are estimated to have decayed by a factor of 2000. The prompt removal of radioactive material from Peach Bottom would have cost \$2.75 million (1974). Delaying the removal for 50 years may drop costs to \$2 million (1974).

□ The 58.6-MW(e) Pathfinder Reactor in Sioux Falls, S.D., operated from 1964 to 1967 to demonstrate the principle of direct nuclear superheat, before it was shut down to repair a main condenser tube break. Upon inspection, technicians observed that two more components had failed — the steam



End Item
Cost Item

Upper table: An estimated breakdown of the projected costs for the prompt dismantlement of a pressurized water reactor, from the Nuclear Regulatory Commission. Labor costs are by far the greatest single expense. The N.R.C. notes that the accuracy of these data is not really to thousands of dollars; four or five significant digits are included, they say, "for computational accuracy."

Lower table: Some of the nuclear activation products in the reactor structure are extremely long-lived emitters of radioactivity. Permanent disposal of these materials is essential and — technically — feasible.

Cost item	Millions of dollars	Per cent of total
Fuel shipment	3.084	7.3
Equipment	1.028	2.4
Supplies	1.949	4.6
Power	4.375	10.4
Activated materials	3.418	8.1
Contaminated materials	6.479	15.4
Radioactive waste	0.866	2.0
Staff labor	11.223	26.7
Contractor services	0.680	1.6
Demolition services	8.012	19.0
Nuclear insurance	1.000	2.4
Total (rounded)	42.1	

Isotope	Half-life	Emitted radiation
Co-60	5.2 years	γ and β
Ni-59	80,000 years	γ and x-ray
Ni-63	92 years	β only
Fe-55	2.4 years	γ and x-ray

separators and the fuel hold-down structure baffle. Repairs would have been so expensive that the decision was made to convert the facility to a fossil-fueled electrical generation plant.

All the contaminated piping outside the containment was cut and removed and end-caps were welded on all open pipes. The turbines were dismantled, decontaminated with a series of high-pressure phosphoric acid sprays and water rinses, and rebuilt for use with the fossil fuel system. A decontaminating cleaning solution was pumped through the heaters, generating about 15,000 gallons of radioactive waste, which were stored. A total of 57,000 pounds of radioactive equipment was shipped from the site for burial.

A new boiler building was then constructed next to the old turbine hall. The new coal-fired plant generates about 60 MW(e) using low-sulfur No. 6 fuel oil. Effluents from the new plant due to radioactive materials remaining in piping are radiologically acceptable under N.R.C. guidelines (10 C.F.R. 20), but the reactor will require further decommissioning.

Experience with Pathfinder suggests that it may not always be practical to convert the steam generator in a large power plant from nuclear power to fossil fuel. Problems abound: turbines may not be adaptable, and the site could be poorly located for delivery of fossil-fuel shipments. For example, a large nuclear power plant requires one shipment of fuel per year, involving four railroad cars, but a coal-fired plant of similar capacity needs 80 railroad cars of fuel daily. In certain areas of the country, such as the northeastern states, it would almost surely be impossible to supply coal to certain generating plants that are now nuclear powered.

□ Probably the most interesting reactor decommissioning experience is on the Elk River Nuclear Reactor. This 22-MW(e) PWR reactor had a fossil-fueled superheater section. The plant, owned by the Atomic Energy Commission (A.E.C.), was constructed in Elk River, Minn., on land leased from the United Power Association. These two principals agreed that in the event United Power chose to waive its option to purchase the plant, the A.E.C. would retire it.

The plant turned out to be unattractive to United Power executives: its profit margin failed to meet expectations and requirements for emergency core cooling and seismic backfits appeared inevitable. The A.E.C. opted to completely dismantle the reactor. The first stage of dismantling began in June,

1972, and took ten months. During this period the pressure vessel, internal piping, and thermal shield were cut into transportable pieces with a remotely operated plasma cutting torch. Radiation levels in the pressure vessel were very high — about 1,300 Roentgen per hour at the shield surface, and over 8,000 Roentgen per hour at the upper core support plate. (An unprotected worker standing next to the core support plate would receive the maximum permissible dose for a three-month period in less than 1.5 seconds.) To reduce their radiation exposure the 15 workers involved in the cutting did their work under water with a commercially available, remotely operated plasma cutting torch. Remote operation also reduced the risk of using the high-current electric device under water.

In all, the metal fragments contained some 10,000 Curies of radioactivity. About 600 tons of scrap metal and 2,650 cubic yards of contaminated and uncontaminated concrete eventually were shipped from the Elk River site to the A.E.C. waste burial grounds in Sheffield, Ill.

The decommissioning was completed in November, 1974, after the concrete biological shield was razed and removed. Total cost to the A.E.C. was \$5.74 million (1974) plus \$800,000 for surveillance and monitoring.

When dismantling larger reactors, workers would have to be protected with more effective — and isolating — shielding; the isolation will require both remote operation and monitoring of the cutting torches. In addition, the thicker, heavier fragments from commercial reactors will be more expensive to handle: additional manipulators will be needed, and current to the plasma torch would have to be higher to cut through the thicker metal. A particularly cumbersome problem would arise if the nuclear facility is a great distance away from a convenient nuclear waste disposal site.

In their report on the Elk River dismantling (WASH 1516 Draft) the U.S. Environmental Protection Agency (E.P.A.) noted potential impacts to the environment from two sources: the radioactive dust generated during the demolition and destruction of structures and the transportation of huge amounts of radioactive material to a waste disposal facility. These hazards were minimized during the Elk River decommissioning by demolishing the radioactive structures inside the sealed containment building and by shipping radioactive wastes at times and over routes of minimal traffic. The same techniques to minimize environmental impacts will

probably be used for the larger reactors. These two areas of potential risk to public safety will probably be major concerns for a utility planning to decommission a major nuclear facility.

At present there is some uncertainty about whether or not an Environmental Impact Statement will be necessary for all decommissioning activities. The E.P.A. may accept an N.C.R. waiver if the expected impacts are sufficiently low.

Economics of Reactor Decommissioning

The financing and benefits of a nuclear power plant may be shared for as long as a century by several generations of humans: ten years are needed to plan, license, and build a plant that should then operate for 30 to 40 years, and ultimately require perhaps 5 to 50 years to decommission.

Thus, a utility considering the purchase of a nuclear reactor must consider that it is embarking on a lengthy commitment to the plant itself and to an additional financial commitment (a single prepayment) to cover the costs of radioactive waste disposal and several hundred years of surveillance.

Several aspects of financing that go beyond simply keeping costs at a minimum face the utility:

- Utility planners are challenged by the need to distribute equitably the lifetime costs of a nuclear power plant among all consumers — those who stand to gain the most benefit from the plant and those who gain much less.

- Present valuing of dollars is essential to a rational analysis of the lifetime costs of nuclear reactors.

- Decommissioning is set so far into the future that inflation, interest, and discount rates are likely to greatly change during the lifetime of the plant. In addition, the N.R.C. may consider requiring utilities to take out an insurance policy on the balance of the decommissioning funds in order to insure that money will be available when decommissioning is to take place.

R. I. Smith and P. L. Hendrickson of Battelle Pacific Northwest Laboratory have identified three viable alternatives for financing decommissioning of nuclear facilities:

- Pay the costs when they are incurred.

- Establish a sinking fund that will be increased by annual payments during the power plant's lifetime.

- Collect the present value of the estimated decommissioning cost before the facility begins operation. (Regardless of which option is chosen, the N.R.C. requires that the reactor decommissioning

will be financially assured by the utility.)

The prepayment plan is considerably more expensive than the first two options. Payment when incurred would be the cheapest; however, it would not be the most equitable means of distributing costs among consumers. An annual sinking fund would probably be the most desirable and equitable means of insuring the financing. The fund could be administered on a continuously updated timetable that would be reviewed by the utility and the N.R.C. annually to insure that sufficient funds would be available at the end of the program.

It has been suggested that monies collected for decommissioning be reinvested in the utility's construction program, thus providing a rate of return equivalent to the utility borrowing cost. When the time arrives, securities could be issued against equity to pay for the decommissioning. The cost of decommissioning would be treated as a negative salvage value. Smith and Hendrickson estimate that this technique would result in an increase of about 0.04 cents per kilowatt-hour of electricity generated by a reactor whose decommissioning cost is estimated at \$44 million (1978). This represents a cost to consumers of about one cent on every dollar spent for electricity.

Although the technology of mothballing a large reactor and dismantling it at a later date is straightforward, the economics are uncertain, because the only practical experience with this procedure comes from the decommissioning of small demonstration reactors built in the 1960s. The experience cannot be directly applied to large commercial power reactors for several reasons. Structural materials in some of the small reactors were subjected to weaker neutron fields than exist in large, commercial power reactors, and, hence, lower levels of irradiation. (There are exceptions — some reactors were operated with very strong neutron fields and the structural material was quite "hot".) And, of course, these small reactors operated for much shorter periods than the 40 years expected of commercial units. As a result, long-lived isotopes — of nickel, for example — did not accumulate to levels expected in commercial reactors. The principal activation product was the relatively short-lived isotope cobalt-60. (Thus, waiting for 50 years has distinct advantages.) In large reactors the doses received by workers could be reduced by as much as 60 per cent if dismantling were delayed for at least several cobalt-60 half-lives. Longer delays would not significantly reduce the total potential occupa-

Source	Total prompt dismantlement (1978 \$ millions)	Pay when incurred (1978 \$ millions)	Annual payment (1978 \$ millions)	Prepayment (1978 \$ millions)
Pressurized water reactor				
Nuclear Regulatory Commission	43	10	15	26
Atomic Industrial Forum, Inc.	35	8	12	21
South California Edison	57	13	20	35
Nuclear Ingenieur Service	88	20	31	54
Vereinigung Deutscher Elektrizitätswerke	57	13	20	35
Boiling water reactor				
Atomic Industrial Forum, Inc.	40	9	14	25
Nuclear Ingenieur Service	104	24	36	64

Element of risk	Likely impact or size
Airborne radioactivity released during dismantling	Maximum dose to general public: 1/100,000 of natural background dose, which, at sea level is about 100 millirem per year
Nonradioactive dust generation	Comparable to any demolition project of similar size
Occupational radiation exposure from dismantling operation	600 to 1200 man-rem total over a four-to-six year period
Nonradioactive occupational hazards	Comparable to other projects of similar scope
Radiation dose to general public from transportation of nuclear waste	5 to 20 man-rem (500-1500 shipments, each for a distance of about 500 miles)
Nonradioactive transportation hazards	No unusual hazards
Generation of radioactive wastes	~ 40,000 cu. yd. (BWR) ~ 15,000-20,000 cu. yd. (PWR)
Generation of nonradioactive wastes	~ 24,000 cu. yd. (PWR) ~ 7,000 cu. yd. (BWR)
Water use	Approximately 300,000 gals.
Transient work force	50-100 people total over a four-to-six year period

Upper table: Estimated costs of prompt dismantlement, according to several sources, and the present value of these costs for various financing options. The estimated cost of a 1,000 MW(e) commercial nuclear reactor, including escalation and interest during construction, delivered in 1988 is approximately \$1.4 billion (1978). A 40-year operating lifetime is assumed, as well as an annual inflation rate of 6 per cent, an annual interest rate of 8 per cent, and a discount rate of 10 per cent.

Lower table: Estimates of the magnitudes of some environmental impacts and considerations likely to occur during the prompt dismantlement of a commercial nuclear power reactor. (Sources: Battelle Northwest Laboratories, Atomic Industrial Forum, Inc.)

tional dose because of the exposure risk already involved in preparing the reactor for mothballing.

Regardless of how costs vary with changes in radiation levels, as long as the discount rate exceeds the inflation rate, delaying the dismantlement operation is always cheaper than prompt action. However, uncertainty in the rate of inflation makes this rationale a risky one over the long run.

About 25 to 30 per cent of the total cost of dismantling will stem from the transportation and disposal of radioactive waste — another crucial and presently uncertain element in cost projections. A review underway by the N.R.C. of current techniques for handling low-level waste may result in changes to existing safety standards and modifications of the methods of waste transportation and disposal. While such changes are unlikely to pose serious technical problems, their likelihood complicates financial projections. The veil of this uncertainty will rise only after the N.R.C. policy on waste management becomes more specific.

Social Impacts of the Decommissioning Process

Well before actually decommissioning a nuclear reactor, a utility will have planned a strategy to deal with the withdrawal of the plant's electricity from the power grid. This action is consistent with the responsibility of the utility (a regulated monopoly) to meet the demands of affected consumers. Thus, planning the construction of new facilities goes hand in hand with decommissioning the old.

The construction of replacement plants — nuclear or fossil-fueled — in general is becoming increasingly difficult because the number of sites in the United States that are environmentally and economically suitable for the construction of power generating facilities is rapidly dwindling. As a result, it is highly probable that new generating facilities will be built on the sites of retired power plants. From the standpoint of local property taxpayers, reuse of the site would be desirable because nuclear power plants generally assume a large share of the tax burden due to their high assessed values. Should a power plant be shut down and not replaced, the site would probably be reassessed at a much lower value, putting a greater tax burden on other taxpayers.

The question of how a plant should be taxed in the course of decommissioning has not yet been tested, and the answer will certainly influence the decommissioning decisions. Should a local govern-

ment decide to reassess and tax a decommissioned plant on the basis of industrial land use, the fiscal burden would be great and the incentive to restore the site to a fully useable condition would be high.

Thus, apart from unfavorable regulatory considerations, permanent entombment could be technically undesirable; the option of mothballing with delayed dismantling may well turn out to suffer from fatal fiscal and financial uncertainties (although this strategy promises to reduce occupational exposure to radioactivity). It appears that prompt dismantlement may be the preferred technique. One thing is certain — the first few utilities to engage in the decommissioning of nuclear reactors can expect a challenge in the courts fully equal in magnitude to the technical challenges on-site.

Waste Disposal

At present six U.S. sites have been accepted by the N.R.C. as suitable for the disposal of low-level radioactive wastes. These sites are licensed to handle and store wastes with specific levels of radioactivity (measured in Curies per unit volume) lower than those in the activated core components handled during the decommissioning process, but they are suitable for other contaminated materials — for example, the final rinse solutions and workers' clothing.

It can be argued that long-lived isotopes such as nickel-59 should be consigned to a high-level waste storage facility, an expensive phase of waste handling. But as yet there is no permanent repository for high-level wastes in the United States, although the production of radioactive wastes began during World War II and has continued since that time.

Little doubt exists within the nuclear power industry that an acceptable solution to the radioactive waste disposal problem eventually will be reached. It would provide the missing link in the nuclear fuel cycle as well as in the decommissioning process (if needed there at all) and is bound to take the shape of a compromise among technical, economic, and political positions. Surely the formulation of such a compromise will keep scientists, engineers, lawyers, and politicians busy for many years to come.

Conclusions

The experience gained from the deactivation of small-scale nuclear fission reactors serves as the basis for projecting the demands likely from the decommissioning of large, commercial reactors. These



Looking up from within the Elk River Reactor containment dome during an early stage of its demolition. (Photo: United Power Association)

histories and detailed cost studies on larger reactors suggest that the retirement of the big reactors need not be excessively expensive, and can have minimal environmental impact. Because of overlapping jurisdictions, the combined inputs of federal, state, and local governments, public utility commissions, and utility companies must be considered in each decommissioning project.

Varying degrees of uncertainty are present in financial, fiscal, and technical facets of the decommissioning process. Certainly people in the industry will breathe more easily after several large reactors have been taken through the process, providing a firm base of large-scale experience.

Further Reading

Bainbridge, G. R., et al., "Decommissioning of Nuclear Facilities: A Review of Status," *Atomic Energy Review*, Vol. 12 (1974), No. 1, pp. 146-160.

Bardenschlager, R., et al., "Decommissioning of Light Water Reactor Nuclear Power Plants," *Nuclear Engineering and Design*, Vol. 45, North-Holland Publishing Co., 1978, pp. 1-51.

Beckers, R. M., *Remotely Operated Plasma Torch: A Tool for Nuclear Reactor Dismantling*. U.S.A.E.C. pub. CONF-731105-2, 1973.

Bonus Nuclear Power Plant. *Decommissioning Final Report*. Puerto Rico Water Resources Authority, San Juan, P.R. Docket 1154-2, U.A.E.C., 1970.

Elk River Reactor Dismantling. U.S.A.E.C. Environmental Impact Statement for Elk River, Minn., WASH-1516, May, 1972.

Giambusso, A., ed., *Four Decommissioning Case Histories*. *Nuclear News*, Vol. 13, No. 6 (June, 1970), pp. 39-58.

Manion, W. J. and Laguardia, T. S., *An Engineering Evaluation of Nuclear Power Reactor Decommissioning Alternatives*. Atomic Industrial Forum, Inc., publication AIF/NESP-009, November, 1976.

Nichols, F. A., "How Does One Predict and Measure Radiation Damage?" *Nuclear Technology*, Vol. 40, No. 1, pp. 98-105.

Reckman, B. J. and Montgomery, C. R., "Planning and Licensing for the Decommissioning of the Saxton Nuclear Experimental Facility," A.S.M.E. publication 73-WA/NE-8, 1973.

Sande, W. E. *Decontamination and Decommissioning of Nuclear Facilities: A Literature Search*. U.S.A.E.C. publication BNWL-1970, May, 1975.

Smith, R. I., G. J. Konzek, W. E. Kennedy, Jr., et al., *Technology, Safety, and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station*. Batelle Pacific Northwest Laboratory publication NUREG/CR-0131, June, 1978.

Steele, L. E., *Neutron Irradiation Embrittlement of Reactor Pressure Vessel Steels*. International Atomic Energy Agency Technical Report Series No. 163, Vienna, 1975.

Stouky, R. J. and E. J. Kohler, "Planned Decommissioning of the Peach Bottom Unit No. 1 High Temperature Gas Cooled Reactor," A.S.M.E. publication 73-WA/NE-7, 1973.

Unsworth, G. W., *Decommissioning of the CANDU-PHW Reactor*. Atomic Energy of Canada Ltd. publication AECL-5687, April, 1977.

Wheelock, C. W. and R. A. Hewson, *Retirement of the Piqua Nuclear Power Facility*. Atomics International pub. AI-AEC-12832, 1970.

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Trend of Affairs

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Nuclear Power

Technology and the Press at Three Mile Island

In ancient Persia, communications was a hazardous profession. A messenger bearing ill tidings could be summarily executed, thus providing at least temporary relief to the unwilling recipient (but at a considerable cost to the reporter).

The "Persian messenger syndrome" still plagues journalists today, although the abuse is now more psychological than physical. Often untrained in the complexities of modern science and its applications, their coverage of technological events has been criticized as superficial, sensationalized, or irresponsible. The nuclear accident last March near Harrisburg, Penn., is a case in point, and media coverage of the event was a major item of discussion in a May 12 "Public Meeting" at M.I.T. ("Three Mile Island: Public Risks and Technical Decisions") organized by students in the M.I.T. Technology and Policy Program.

Laurence Stern (Assistant Managing Editor for National Affairs at the *Washington Post*) conceded that many journalists are intimidated by scientific jargon. "Rads" and "rems," for example, are not part of their general vocabulary. In order to overcome the "terminology problem" and to more clearly identify the issues, many have argued that journalists covering science and technology should improve their own knowledge in these areas. Fred Jerome, Public Information Director for the Scientist's Institute for Public Information, suggested that "continuing education" among newsmen would help, as it does in other professions (where it is often a requirement). But he stopped short of suggesting that science writers actually be scientists. "There is a certain value," Mr. Jerome said, "to 'generalist' newsmen. They feel what the general public feels, they doubt what the public doubts, and they ask the questions that the average person wants answered."

James Brann, Chairman of the Department of Journalism at Boston University, disagreed, citing the "desperate need for well-trained science writers, as well as for editors to recognize that need." And although Mr. Stern also believes that scientific training would certainly improve a reporter's credibility, many "technical" stories are in fact political. "You don't need a course in college algebra to have covered the May 6 anti-nuclear rally in

Washington," he said.

At Three Mile Island, for which Mr. Stern coordinated the *Post's* coverage, there was no shortage of technical assistance to help journalists through technical complexities. "The problem," he said "was the babble of confusion and contradiction within the technological priesthood itself." "Contradiction among experts is certainly the most serious problem faced by journalists," agreed Professor Brann. "Who can you trust, and who can you believe?" A basic revelation of Three Mile Island, moreover, was that "nobody indeed does know" the answers to many of the questions on technological crisis-management and long-term effects, he said.

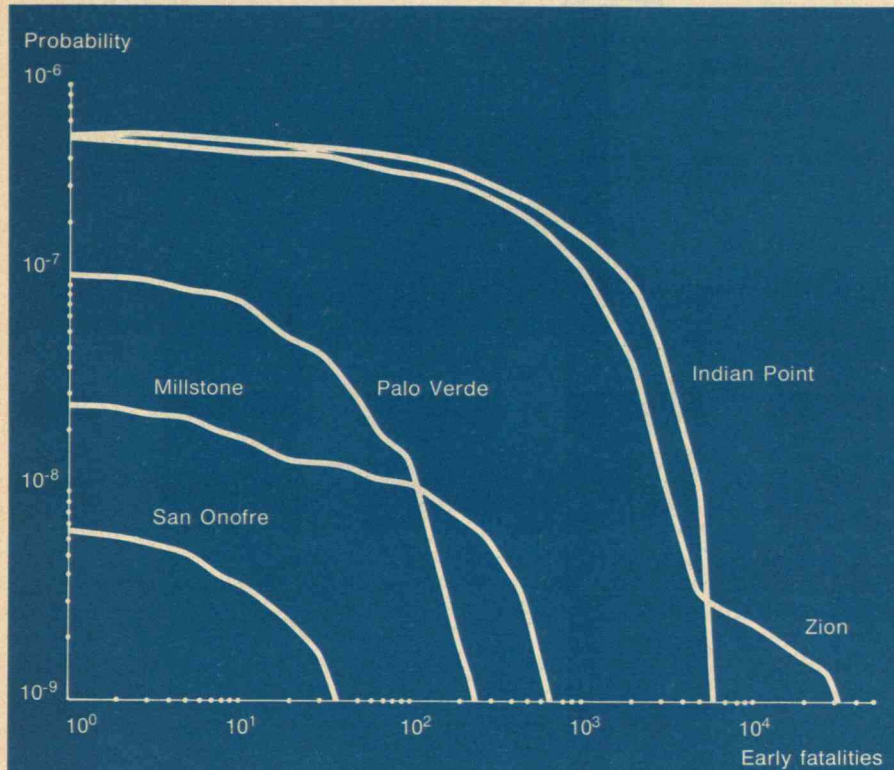
Ironically, such a difference of opinion was manifested at the meeting by two senior nuclear engineers from the Boston Edison Co. during the agenda item "Review of technical aspects of nuclear energy and summary of events at Three Mile Island," intended to be an objective post-mortem. But they simply could not agree on which of the failures — if corrected in time — could have averted the "transient."

A fundamental problem facing the press is the uncooperative, elitist attitude of many in the scientific community. The term "journalistic," in fact, is often used pejoratively by scientists and engineers. It is usually easy, they have learned, to scare reporters away with a smokescreen of jargon, or simply to withhold a subtle but important detail. Stern recounted an incident that occurred during the Three Mile Island episode, when a Metropolitan Edison vice president admitted to the governor of Pennsylvania that his company had released radioactive gases. "Have you told the press?" he was questioned. "No," he replied. "They didn't ask!"

On several occasions during the meeting, Ms. Lois Harris (a member of the "Gray Panthers" who wished to identify herself simply as "part of that great talked-to mass — the public") reminded participants how easy it is for "experts" to run things and remain unscrutinized. "Why don't we talk about communication *with* the public," she asked, "instead of *to* the public?"

Such improved communication would require new and sustained efforts by scientists and journalists alike: greater humility on both sides; enhanced familiarity with the other's mission, methods and language; and a constant reminder that it is the public, after all, which they both serve. — S.M. □

This log-log plot shows the probability of early fatalities — people dying within several weeks or months — that would result from the meltdown of six operating nuclear reactors with subsequent release of radioactive gases to the atmosphere. (Data: J. L. Sprung)



Nuclear Insurance: How Much Is Enough (and from Whom)?

Did the nuclear accident at Three Mile Island deal a staggering blow to the nuclear power industry or was it the catalyst for changes that will enhance the nuclear option? Plant designers are busily trying to apply what they have learned from it, and have scrambled back to their boards to finesse their craft — adding a valve here, a manual control there, and perhaps an additional backup system. Power company executives are hard at work to reassure concerned shareholders and an increasingly polarized general public. And the U.S. Congress has built an agenda of unresolved nuclear-related issues to be debated in rapidly approaching hearings. For example, on the July schedule of the Interior and Insular Affairs Committee, chaired by Congressman Morris Udall of Arizona, is the Price-Anderson Act, which since 1957 has strictly limited the public liability of nuclear plant owners.

Under the terms of Price-Anderson, plant owners must buy private insurance to cover the first \$140 million of public liability claims (which must be filed within 20 years of the pertinent nuclear accident). If damage claims exceed this amount, owners of all operating reactors must themselves contribute up to \$5 mil-

lion each to a pool of insurance funds. The federal government then will pay the remainder of claims up to a total of \$560 million for any one accident, and should it declare a region to be a "disaster area," could provide additional relief funds. But total assured protection to the public is limited to \$560 million per accident.

The Three Mile Island incident suggests to many observers that this 22-year-old legislation is not up to real-world challenges. According to Robert Hunter, Deputy Federal Insurance Administrator, even a precautionary evacuation of the Harrisburg area would have caused damages in the "\$3 to \$17 billion range." Four class-action suits already filed in Pennsylvania seek total compensation "well beyond the \$560 million limit of Price-Anderson," according to Gary Stoyer, legislative aide to Congressman Ted Weiss of New York.

Congressman Weiss had concluded long before Three Mile Island that Price-Anderson needed modification, and he introduced a bill, H.R. 789, to update and improve the Act early this year. "Unlike the Price-Anderson Act, which mandates an automatic federal subsidy for nuclear power insurance," he explains, "my bill

would entail use of federal funds only in the event of a major catastrophe where victims' claims exceed a plant's private insurance coverage, a plant's total assets, and the proportional contribution toward an industry-wide pool. Even then, federal monies would be used only to provide interest-bearing loans."

In addition to taking the federal government out of the nuclear insurance business, H.R. 789 has other remedial provisions. It would remove the current \$560 million ceiling on public liability and do away with the 20-year statutory limitation on claims. (Recent epidemiological studies suggest that delays of more than 20 years may occur between exposure to radiation and the onset of disease.)

Price-Anderson provisions would be hopelessly inadequate to meet the challenges of a major accident according to the results of a hypothetical study by J. L. Sprung and his colleagues at Sandia Laboratory (Sandia Laboratory Reports SAND 78-0556 and 78-0574C, Oct., 1978 — see discussion on p. 32). Dr. Sprung calculated the "early fatalities" that would result if any one of eleven operating reactors should suffer an accident in which a "non-buoyant plume" of "relatively cold" radioactive gases were released to the atmosphere. About 30,000 to 40,000 people would die within several months following such a release from the Zion nuclear reactor, situated between Chicago and Milwaukee, he says.

In addition to insurance, other kinds of protection and clarification may be needed: for example, a federal tort law to deal with legal ambiguities that could arise from jurisdictional conflicts among existing state tort laws dealing with nuclear accidents (since radioactive plumes do not recognize geopolitical boundaries). According to Ron Curry, staff counsel of the Interior and Insular Affairs Committee, several such key issues will be weighed at the Committee hearings including:

- ☐ Types and amounts of nuclear liability protection needed;
- ☐ Proper amount and charges to utilities for federal indemnification;
- ☐ Nuclear accidents to which the Price-Anderson Act does not apply;
- ☐ Nuclear waste facilities; and
- ☐ Nuclear proliferation.

"The time has come for nuclear power either to stand or fall on its own merits," admonishes Congressman Weiss. "No other method of energy generation enjoys a similar liability limitation, and Congress now has a clear duty to end this unfair underwriting of atomic power." — L.A.P. □

Children

Children's Advertising: Behind the Candy-Coated Message

There was a time when Popeye got his super-powered energy from spinach and Bugs Bunny's favorite between-meal snack was carrots. Veggies were in.

The scene has changed.

On February 24, 1979, a typical Saturday morning, members of the Center for Science in the Public Interest (C.S.P.I.) watched children's television programming and listed the products advertised. On the three major networks, from 8:30 a.m. to 12:30 p.m., they tallied 154 commercials of which 72 were for heavily sugared cereals, 35 for candies, 23 for fast food restaurants, 5 for cookies, 5 for powdered soft drink mix, and 5 for toaster tarts.

Do the high-powered selling techniques used in these advertisements, which typically involve groups of children, cartoon characters, or a combination of both, deceive and exploit children? Do some of the products threaten children's health? Consumer protection advocates, many health experts, and public interest groups say so; advertisers and broadcasters disagree (see *"The Case of the Decaying Teeth: Filling in the Gaps," March/April, p. 70*).

The debate has reached the Federal Trade Commission (F.T.C.), whose staff has recommended three specific actions:

- ☐ Banning all advertisements directed at children less than 8 years old;
- ☐ Banning all advertisements for known cariogenic (decay-causing) foods for children 8 to 12;
- ☐ Requiring "corrective advertising" that promotes good nutrition.

More than 130 witnesses representing advertising, broadcasting, and consumer interests, as well as experts in child development, education, dental health, and medicine locked horns in F.T.C. hearings this March. "In the end this debate is between two views of human nature," says Bill Moyers, who produced a televised documentary program on the subject. "One treats young children as feeling, wondering, and wonderous beings to be handled with care because they are fragile. The other treats them as a vast collective to be hustled."

Testified Robert J. Keeshan (who, as Captain Kangaroo, hosts his award-winning children's television program): "My 30 years experience with children and television have taught me many

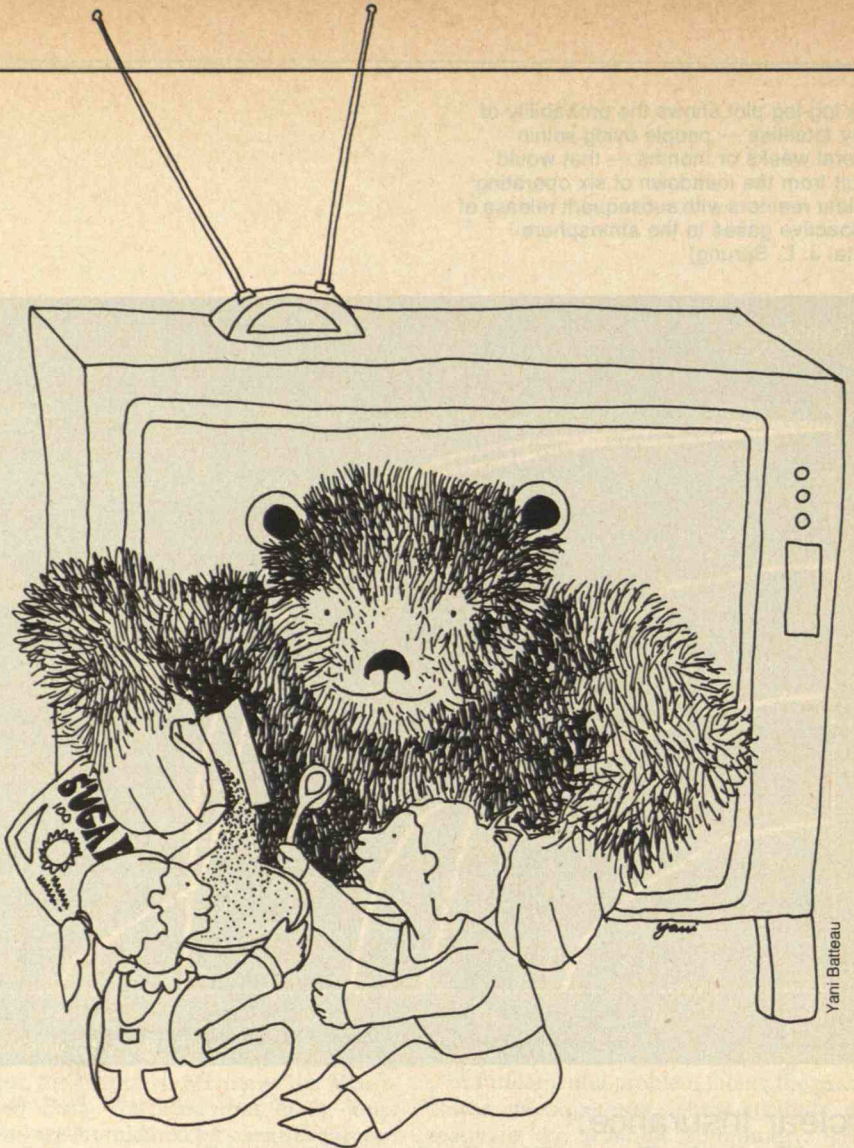
things. Perhaps nothing is more important than understanding that young people are intelligent human beings and must be treated with respect." Mr. Keeshan also suggested that commercials can create opportunities for parents in making decisions with their children about which items to buy.

But a recent ABC News-Harris survey showed that 73 per cent of American adults favor a ban on children's advertising, which they charge turns children against their parents and undermines adult authority. Young children have little or no purchasing power, so that advertising creates desires in them which they cannot personally fulfill, putting pressures on parents, and often leading to mutual frustration. Dr. Robert Abramovitz of Yale University's Child Study Center told the F.T.C. that commercials intensify this problem by promoting instant gratification just when a child is struggling to develop control over even the simplest urges such as hunger. "I doubt that we, or the F.T.C., ever would have gotten involved in this issue if the television messages that reached children were ones promoting cooperation, friendship, safety, and a diet that was well-rounded and healthful," said Michael Jacobson of C.S.P.I. Sugary

foods are cariogenic, he pointed out, especially when consumed as between-meal snacks, and they can also contribute to obesity and nutritional deficiencies. Dr. Sheldon Margen, Professor of Human Nutrition at the University of California, Berkeley, described evidence that associates the consumption of sugar with the growing incidence of heart disease and diabetes.

Advertisers and broadcasters protested the F.T.C. recommendations, charging that government regulation would violate their right to free speech. Claims of the critics are unsupported by sufficient medical and other evidence, they countered. For example, how can it be proved that television commercials have caused an increase in sugar consumption in the U.S., when the use of sugar has also grown in Sweden and in the U.S.S.R., where there is no television advertising? F.T.C. regulation of children's advertising is not justified, they held; rather, the broadcasting companies should regulate themselves.

Contending that self-regulation has not worked in the past, proponents of the ban went on to describe subtle deception techniques now in use. Professor Rose Goldsen of Cornell University testified that new technologies of filmcraft deceive



children's perception of a product by distorting size and performance with trick camera angles, perspective shots, and special lighting. Parades of images assault the senses in rapid-fire succession, then give way to dreamy slow motion. Such techniques, aided by mood music, are chosen for their emotional effect — and are enough to divert even an adult from logical reasoning. And what of children's disappointments with misrepresented products — and their perceptions of the trustworthiness of the adult world in general?

Final F.T.C. action is expected by the end of 1979. In the meantime, ABC has voluntarily cut its child-directed advertising by 20 per cent, and more nutritional messages are appearing on the networks.

Loss of revenue from an advertising cutback is an important issue yet to be reckoned with. But profits from the rest of broadcasting can be used to pay for at least some of the children's programming, said Peggy Charren, President of Action for Children's Television (Newton, Mass.).

Still to be discussed is children's programming itself, which is certainly not beyond reproach. "The commercials are the only reason that kids put up with those awful [Saturday morning] cartoons," says Marvin Kitman, television critic for *Newsday*. He envisions the clustering of all commercials at the beginning of regular program material. "These commercial clusters would get better ratings than the children's programs," he quipped. Most kid's shows are junk, and could stand considerable upgrading, said Kenneth Mason, president of Quaker Oats Co., to a group of television advertisers in Chicago earlier this year. He suggested that the three major networks collaborate. Instead of almost identical strings of cartoons on each station on Saturday mornings, he would have one three-hour program shown simultaneously on all stations. Each network could produce a set of these and rotate commercials, having better programming for less money.

Mr. Mason would like to see all the stops pulled out. Fed up with business assuming the lowest common denominator where the public is concerned, he would like to see all the power, talent, and brains of business work together toward quality in television, advertising, products, and our lives. Surely the youngest members of our society deserve no less. — S.K. □

Lead Poisoning: Is History Repeating Itself?

Despite knowledge of the toxic effects of lead, the citizens of the Roman Empire persisted in their use of the metal in their utensils; they paid dearly for this indiscretion. The metal remains a serious environmental pollutant today and poses a particularly severe threat to the health of children.

About 200 children die each year of lead poisoning in the U.S.; about 12,000 to 16,000 are treated and survive. Recent research suggests that as many as 500,000 children in the U.S. each year suffer various degrees of lead-induced dysfunction.

Low concentrations of the metal may produce symptoms so much like those of viral infections, teething, and psychological stress that lead poisoning is often not diagnosed in its early stages. The cost of delay is heavy: about 30 per cent of children who survive lead poisoning suffer palsy and partial paralysis from permanent brain damage. Virtually all survivors exhibit some degree of hyperactivity and some loss of intelligence, or both.

There is a growing suspicion that a

"threshold" level of lead in a child's body — a concentration above which "clinical" poisoning exists and below which toxic effects are absent — does not exist. Before 1970, 60 micrograms of lead per 100 milliliters of blood was considered a safe threshold level. During that year the U.S. Surgeon General revised that figure downward to 40 micrograms per 100 milliliters and in 1975 the Center for Disease Control (C.D.C.) of the U.S. Department of Health, Education and Welfare lowered it to 30 micrograms per 100 milliliters, cautioning that even at this level children are at risk.

A recent study of New York City children by Dr. Oliver David of the Downstate Medical Center in Brooklyn, N.Y., substantiates C.D.C.'s caveat. His findings suggest that lead exerts its effects over a continuum, and that even very low concentrations can cause dysfunction, which perhaps may not be clinically evident.

Dr. David's study involved 589 children 5 to 12 years old, none of whom had clinical lead poisoning, none of whom had been referred for learning problems, and all of whom had subclinical blood-lead levels. All were free of obvious psycholog-

Where the Lead Comes From

For children living in older houses and apartments, the single most important source of environmental lead is leaded paint. Other sources, not ranked in any particular order, include:

- Dust falling from walls and ceilings that are covered with paints containing lead;
- Airborne lead from leaded gasoline and industrial effluents — an average of about one kilogram of lead per U.S. citizen per year;
- Tobacco smoke;
- Drinking water, especially in areas where water pipes are old, known to contain lead, or both;
- Snow and ice — ingested by children in urban areas who eat snow and lick icicles contaminated with lead;
- Food — in particular, vegetables grown in urban garden plots, where both soil and air are often heavily contaminated;
- Gift wrapping papers coated with leaded pigments that may be chewed by children, burned and

sent into the atmosphere in fireplaces or incinerators, and leached into groundwater from dumps and landfills.

□ The clothes of parents who work with lead, such as battery workers.

We modern-day humans are exposed to amounts of lead that "increase the concentration of biologic lead 500-fold above natural levels," according to Jon Ericson, Assistant Professor of Anthropology at Harvard University. Professor Ericson was principal investigator in a recent study performed by scientists at Harvard and the California Institute of Technology (*New England Journal Of Medicine*, April 26).

Their astounding findings: the level of lead in the remains of modern-day humans in the U.S. and Great Britain is 500 times greater than that in the bones of Peruvians who lived and died 1,600 years ago. — A.H.D., Jr. and L.A.P. □

ical problems and had blood levels within a range of 10 to 44 micrograms per 100 milliliters of blood, averaging 18.3 micrograms per 100 milliliters — considered normal for city children.

He evaluated the children's behavior with parents, teachers, and guidance counselors and found their conduct, learning progress, and general level of activity varied, as expected, with age, sex, and cultural difference — and *also* with variation in their subclinical blood-lead levels. Despite the very low levels present, the more lead there was, the greater were behavioral problems and hyperactivity, and the poorer learning progress. After making these determinations he used the drug penicillamine to remove the lead from the bodies of a number of children suffering hyperactivity and mental retardation — both major symptoms of lead poisoning. After two months of such treatment, 60 to 70 per cent of these children showed noticeable behavioral improvement and the average group I.Q. increased from 90 to 97. Similar studies with children carried out recently in Montreal, Dusseldorf, and Boston support Dr. David's hypothesis that even minute amounts of lead in a child's body affect behavior and learning.

How can lead be removed from the body? Substances called chelates can be used to sequester lead within body tissues, from which the lead-containing form of the chelate is then eliminated from the body through the urine. But chelates currently available for treating lead poisoning are capable of damaging the kidneys if used to excess or for long periods of time. Moreover, they succeed mainly in removing lead from bone — not from nerve and brain tissue. For these reasons chelates are used only in cases of acute lead poisoning. Children with less severe cases should be monitored periodically — and in all cases the source of the environmental lead must be found and eliminated.

A new regimen with derivatives (esters) of a chelate called DTPA (diethylenetriamine-pentaacetic acid) may provide a treatment. DTPA has been used at Argonne National Laboratory to remove plutonium and similar radioactive heavy metals from bone and soft tissues of mice, rats, and dogs. Recently it has been found that different esters of DTPA remove lead selectively from different tissues of mice. Argonne researchers Dr. Arthur Lindenbaum, Dr. Elsie Sorensen, and Elizabeth Moretti suspect that a medical course combining several such esters "may be worthy of consideration for the treatment of human lead poisoning." — A. H. Drummond, Jr. □

Technology and the Workplace

Changing Values of the MBA

Members of the new generation of business school graduates are as bright and committed as ever. But they bring to the marketplace and to the firms for which they work a new emphasis on individual interests and values that can be easily misread.

They are not hostile to employers or to the traditional measures of success in corporate life, nor selfish in preserving personal prerogatives. They simply embrace a new allegiance to the values of the individual — to family, to creative experience, to the exciting aspects of vocational and avocational life.

Louis L. Banks' understanding of the world of business dates to his career in the editorial offices of *Fortune* magazine, where he was Managing Editor before moving to become Editorial Director of Time, Inc., in 1970. During the past four years he's taught America's next generation of executives first at Harvard Business School and for the past two years in the Sloan School of Management at M.I.T.

He has seen a fundamental change in Cambridge, he wrote late last fall in *Harvard* magazine, "... the outcropping of a broad and basic change in American society which has bedrock implications for all organizations that owe their survival to creative people."

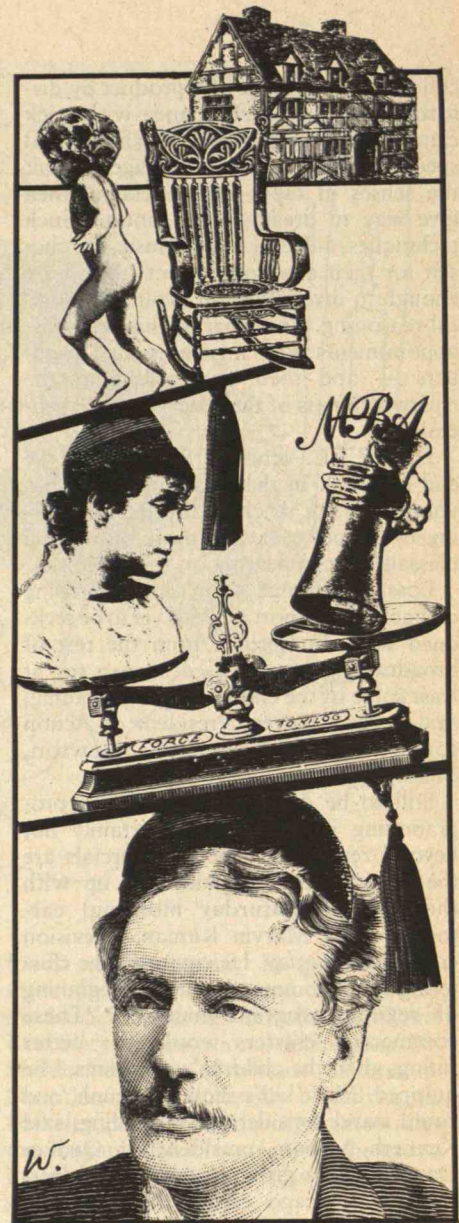
Examples:

□ The young business school graduate who takes a lesser job because the company that offers it also offers the spouse opportunity to find a job in his or her field.

□ The rising young salesperson who declines an executive job on the West Coast because of a child who needs to finish at the elementary school where friendships have been established.

□ The promising junior executive who, invited to spend a weekend "talking shop" with the chief executives at the company retreat, asks if it couldn't be done on Thursday or Friday.

When Professor Banks asked Harvard Business School students about the growth in importance of individual interests he found that: "... they put a higher premium on their individual values than on 'making it' in corporate terms that conflict with those values." Or, quoting Professor Richard Beckhard of the Sloan School, today's students are: "sim-



Karen Watson

ply seeking to bring personal values into play *with* organizational values."

It is not a decline in the work ethic, says Professor Banks, "... not an anti-business or anti-organization trend per se. But it will demand accommodations between conventional business values and individual values of a scope and kind we have never quite seen before. ... If those who manage our large, effective organizations can learn to achieve the rewards of efficient, large-scale coordination of complex factors and at the same time give play to creative individual development and expression, the American business system ... may be headed for a whole new level of productive achievement." — J.M. □

Staying Among Friends in New England

New England is now the nation's minicomputer manufacturing center. But continued rapid growth of this and the related field of telecommunications will be bad news for New England chambers of commerce. For the industry, which now relies on New England's skilled labor, will have automated, and then it will be ready to seek the cheaper labor resources of South Carolina or even South Korea.

It's been that way ever since the industrial revolution brought us our first mills, says John S. Hekman, assistant professor of economics at Boston College. Skilled labor is today needed in gun-manufacturing, minicomputers, and jet engines; they're still here. It's no longer needed in textiles, machine-tool-making, and boots and shoes; they're gone.

But another factor works to keep some of New England's industries here despite high energy and transportation costs: "agglomeration economies," Professor Hekman calls them: "one firm benefits from the presence of many other firms in close proximity." You may never have thought of it that way, but this is what keeps the consulting business here. People who study technology, business, economics, medicine, education — and lots of others — need each other, and they need the resources of colleges and universities for stimulation, information, and (perhaps most of all) part-time help from faculty and graduate students. — J.M. □

Garbage In, Garbage Stays

The technology-society interface maintained by state and federal governments is more than a little besmirched. Consider this data gathered by Professor Kenneth C. Laudon of the City University of New York's John Jay College:

□ Under the Supplemental Security Income Program, the Social Security Administration pays some \$6 billion annually to 4 million beneficiaries. Up to about 1975, the S.S.A. admitted that errors — over- and under-payments and payments to ineligible — existed in 20 per cent of the case load file. By 1977, Professor Laudon told the American Association for the Advancement of Science last winter, errors experienced by beneficiaries averaged only 13.4 per cent nationally, with highs of 17 per cent in Boston and Denver. But the

total 1977 error rate may have been close to 20 per cent, because these statistics do not include eligible persons not receiving benefits or ineligible persons receiving them.

□ According to the New York Legal Aid Society, only 27 per cent of the records in the New York criminal history system are accurate. In 45 per cent of a good-sized sample, no formal disposition was shown following arrest, leading to the probability of active records for many people arrested but never convicted. The high error rate is especially serious because New York data — errors and all — are proposed to become part of a national criminal records databank being set up by the F.B.I.

□ Errors in databanks of the Internal Revenue Service are hard to analyze. I.R.S. itself thinks about 27 per cent of its records have problems of some kind, ranging from arithmetic errors to deliberate irregularities introduced by taxpayers who develop the data in the first place.

Some errors are probably inevitable, but Dr. Laudon is convinced that too little is known about how they come about and how they can be managed and controlled. Indeed, he told the A.A.A.S. early this year, "our knowledge in this area is virtually non-existent."

"The most important questions," Dr. Laudon told the A.A.A.S., are the frequency, nature, and origin of error in large computer record systems; what management policies can reduce errors and at what cost; and what new national information policies can we create to attain "acceptable levels of error." An important clue to the solution, which is almost common sense, emerges from Dr. Laudon's first research: our most accurate information systems are those which operate within a single organization in a competitive environment, which deal with simple transactions, and in which failures are visible.

The Privacy Act, which gives subjects of databanks the right to review their records, has had little effect on the error rate because most citizens find both the Act and the means of locating the data they seek, too complex. And the act is a red herring drawn across the issue of accuracy, he says: "Concern with security and confidentiality has diverted [the average citizen's] attention from the more significant [to him] problems of accuracy, timeliness, and completeness." Clearly the old saw about "garbage in, garbage out" is not quite right. "Garbage in, garbage stays," said Professor Laudon. — J.M. □

Health

How to Decide About Low-Level Radiation

Radiation as a result of exposure to nuclear power generation providing one kilowatt of power per person per year in the U.S. would cause less than 0.5 excess cancer deaths per million persons per year. The risk of death is equal if you smoke one cigarette every two years. There will be 20 to 100 excess deaths from lung cancer per million persons exposed per rad of low-level radiation.

Such statements, embracing very large and very small numbers, imply a quality of understanding of the relationship between low-level radiation (the kind that comes from clinical x-rays, distant nuclear reactors, and radioactive materials) and health which in fact does not exist. But there seems no way to express the few things we know without masking the many things we do not in this complex and sensitive arena. Setting permissible radiation levels or even guides remains "essentially an arbitrary procedure," Dr. Jacob I. Fabrikant of the University of California's Donner Laboratory told the American Association for the Advancement of Science early this winter.

Uncertainty is rampant. For example, the relationship between the length and intensity of exposure to ionizing radiation and cancer is not understood. "Dose-response information for humans is highly uncertain, particularly at low levels of dose," said Dr. Fabrikant. There is no reason to assume, or for that matter not to assume, that the incidence of cancer rises in direct proportion with dose — except that this assumption provides a strategy for calculating risk — and decisionmakers can use etiological data only when put in the context of risk. In general, the "accepted" figure of risk is one to five excess radiation-induced cancer cases per million people irradiated per year per rad. This rate varies with the source of the radiation, the rate and duration of the dose, and the age, sex, and genetic susceptibility of the subject — but no one knows how errors may be compounded in the calculations of risk.

Still, we have learned a good deal about radiation risk in relation to the incidence of cancer in bone marrow, thyroid, breast, and lung. But we know far less about bone itself and the digestive organs; radiation-related "solid" cancers are now more common than leukemia, and no one knows why.

After citing all these reservations, Dr. Fabrikant nevertheless came back to the conventional ways of expressing radiation exposure risk: 10 to 60 excess leukemia cases per million people exposed per rad (based on data that are by far more consistent than for other cancers); a lifetime risk of 20 to 150 excess thyroid neoplasms per million people exposed per rad; 30 to 200 excess breast cancers per million women per rad, 20 to 100 excess lung cancer deaths per million persons per rad.

For these figures to be more than abstractions, they have to be compared with other risks we all sense or experience. A tricky business, because practically no risks are truly optional. So it is that Dr. Fabrikant estimates the risk from low-level radiation to be about 1/50th of all risk experienced in a lifetime of work in a government and service occupation, 1/500th of that experienced by a miner.

But even this accounting leaves out factors that should be in the computation. Exposure to low-level radiation is sometimes necessary for extending life; medical radiation, for example, surely saves more lives than it costs when used for diagnosis. And it neglects economics: removing from milk all traces of strontium-90 from atomic bomb testing in the 1960s might have cost a few pennies a quart, but that works out to \$20 million for each case of cancer likely averted.

Dr. Fabrikant's conclusion: "very few firm conclusions" are now possible in the realm of public health policy for radiation protection standards, and setting permissible levels is more than "an exercise in statistical theory or laws of chance." After "our best scientific knowledge and advice" are in hand, said Dr. Fabrikant, the issue becomes a "societal and political" one, "to be settled by men and women of business and law." — J.M. □

Technology Abetting the People/Doctor Gap

Why are so many people skeptical and distrustful of physicians and hospitals? Why are people turning to self-health care as an alternative?

To answer these questions David Rosner of the Department of Health Care Administration at City University of New York says you have to look at the wide social gap between the public and physicians. "The medical model of health and illness is isolated from social realities," so there is "a discordance between the popula-

tion's expectations and the physician's view of his role."

The problem is that almost 90 per cent of today's physicians are specialists who have a kind of tunnel vision: they "do only what they are trained to do" and leave the rest of their patients' problems to someone else.

It was not always this way. In a simpler era, before the end of the 19th century, hospitals were small total-care institutions woven into the social fabric of the community. They were governed by lay boards of directors and served relatively small numbers of patients. At a time when there was a close link between morality, poverty, and well-being, patients stayed in hospitals for long periods for both physical and social cures. For example, if patients were unemployed, they were trained to work; if the patients were poor, they were trained not to be poor. The institutions were serving the goals and needs defined by the trustees themselves. Their financing came through the moral stewards and political machinery of the city.

Political reform movements and changes in the demographic and social structure of the cities during the progressive era at the turn of the century destroyed the community and financial base of hospitals. The emergence of the germ theory redefined medicine and medical care and undermined the legitimacy of the trustees as the caretakers of the populace. That power was then invested in the hands of physicians with increasingly narrow specializations and growing dependence on complex technology and elaborate procedures. In this situation, a physician would rather act than not, and this leads to "unnecessary" treatments — such as surgery, according to Mr. Rosner, who spoke early this spring at a seminar of the Harvard-M.I.T. Program in Health Sciences and Technology. The results are rising costs and increasing public concern about what the medical dollar is buying. One result of this trend is the alienation of medical practitioners from those they serve.

Now, says Mr. Rosner, there is a move to turn the clock back — to control high technology, to decrease the spread of specialization, and to promote more basic care such as primary preventive medicine. It reflects "the prevalent undercurrent of feeling that hospitals are not focused around the health needs of the consumer," Mr. Rosner said. It may be viewed as "an attempt to find methods to make hospital boards and trustees more responsive to community needs." — Steven Frann □

The Hidden Second Hazard of Cigarette Smoking

How do cigarettes jeopardize their smokers' health?

In two ways, according to a new report from M.I.T. and the Harvard School of Public Health:

□ By providing irritants and even carcinogens, which are inhaled into the lung as constituents of the smoke — the commonly recognized mechanism by which cigarette smoking is linked to lung disease;

□ By reducing the ability of the lungs to clear themselves of inhaled airborne impurities, including toxic (and perhaps carcinogenic) dusts in the urban atmosphere.

The results, reported in *Science* (May 4) by David Cohen of the Francis Bitter National Magnet Laboratory (M.I.T.), Satoaki F. Arai of Tokyo Denki University (he was on leave at M.I.T. when the study was made), and Dr. Joseph D. Brain, Professor of Physiology at Harvard's School of Public Health, help explain a puzzle: why asbestos workers who smoke have such a sharply greater risk of cancer than the non-smokers who may work beside them.

The research was simple in concept, if not in execution. A number of smokers and non-smokers were asked to inhale a small amount of ferromagnetic dust. Thereafter, for 12 months, the fraction of ferromagnetic particles remaining in each subject's lung was measured by a super-sensitive magnetometer.

The findings: half the dust remained in smokers' lungs at the end of the year, but only 10 per cent of it in non-smokers' lungs — "a dramatic separation between smokers and non-smokers," the authors said.

The studies, now being expanded to a larger sample of smokers, imply that smokers run a significantly greater risk of disease from harmful airborne substances than do non-smokers, assuming that the longer such materials remain in the body, the greater is the chance for them to do their mischief. — J.M. □

We asked Americans:

'Who Should Suffer from Future Energy Shortages?'

In a recent poll, Americans supported sharing energy shortages among all groups of consumers:

"Is it your feeling that any cutbacks that come in the use of energy by the American public should be about equally divided between all groups of Americans or is it your feeling that some groups of the American consuming public should have to cut back a good deal more or less than most people?"

Divided equally	65%
Not divided equally	28%
Don't know	7%

Source: March 1979 national probability sample, by telephone, of 1,000 adults. Conducted for Union Carbide by Roger Seasonwein Associates, Inc.

A majority said 'All of Us.'

A majority of Americans believe that all groups in our society should share the burdens of any future energy shortages about equally. They reject the idea that some groups ought to be cut back more, or less, than others. Apparently, Americans have not lost their sense of fairness and shared sacrifice at a time when, as was shown in another Seasonwein poll, 50 percent felt that in the next few months we will be facing energy shortages.

While these questions were part of a survey of American attitudes on energy conservation, they shed light on the related questions of what the public feels is fair in dealing with energy shortages. And in developing public policies for allocating energy in a future shortage, our leaders will have to consider public attitudes as well as such economic realities as the importance of energy resources used as raw materials, rather than fuel.

Energy as a building block.

Most Americans think of energy as a fuel; as a source of heat, light or motion at home and on the job. But energy materials such as oil and gas are also used by companies like Union Carbide as raw materials—feedstocks—for which *there are now no ready substitutes.*

- Petroleum and natural gas provide the basic building blocks for products as diverse as fertilizers, chemicals, plastics, medicines and fabrics.
- In 1976, over 6 million American jobs depended on petroleum and gas feedstocks.
- The value of the products made directly from these feedstocks was \$20.3 billion higher, in 1976, than the value of the feedstocks themselves.
- The petrochemical industry is one of the few U.S. industries to maintain a favorable balance of trade; in 1976 it amounted to \$4.1 billion.

Feedstocks—a small but vital percentage.

Only a small part of America's enormous use of energy resources goes for feedstocks, but that small percentage is vital.

- The oil and gas used for feedstocks in 1976 equaled just 4.1 percent of America's total oil and gas consumption.
- Because there are no ready substitutes, cutting back feedstocks would have more severe effects on our economy than cutting back other uses of energy resources. Many jobs and the availability of essential products are at stake.

Where Union Carbide stands on energy supplies.

Union Carbide now uses about \$2 billion worth of energy resources for fuel, power and raw materials per year, and we have a proven commitment to conserving energy resources and using them wisely. By the end of 1978, we'd reduced our energy use per pound of product by more than 15 percent compared to 1972. And we have recently announced new conservation goals that would bring our 1985 energy use level down *an additional 15 percent*, compared to 1972.

Union Carbide supports public policies, including the use of market prices, that would encourage domestic energy production and conservation. We support policies for dealing with shortages that would share the burden equitably and that would recognize that petroleum and natural gas feedstocks are irreplaceable and vital to our society.

This advertisement is part of a continuing series on public opinions and national concerns. For more information, write for your complimentary copy of "Public Attitudes on Energy Conservation," a report of the nationwide survey.

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Last Line

Technology Policy and *E Pluribus Unum*

What is your stance on "pluralism?" What exactly is pluralism?

Webster's New Collegiate Dictionary defines it as "a state of society in which members of diverse ethnic, racial, religious, or social groups maintain an autonomous participation in and development of their traditional culture or special interest within the confines of a common civilization."

If this sounds like what America is thought to be, or used to be, or ought to be once again; and if one is concerned about the slackening rate of "innovation" — that vigorous process which used to be considered by many as indigenously American; then "pluralism" sounds like a mighty fine strategy, as John F. Kennedy used to say, "to get America moving again."

Pluralism turned out to be the word second-most-often heard — after "inno-

vation," of course — at an International Conference on Science and Technology Policy at New York University in late March. There was talk about pluralism in research and development funding, pluralism in the composition of technical policymaking bodies, pluralism in the availability of expertise, and pluralism in what constitutes expertise. The ways in which to apply pluralism clearly achieved a plurality.

Most university research, observed Geoffrey Place (Vice President for Research and Development at the Proctor and Gamble Co.) is government funded. And although new systems for managing federally-sponsored research are desirable, at least as important are other sources of funding — especially from industries and the users themselves. What we need, in other words, is "pluralistic funding." Philip Handler, President of the National Academy of Sciences, agreed. "In research," he said, "as in ecology, resilience is the name of the game. And that requires diversity."

Gösta Lagermalm, Senior Adviser in the Swedish Board for Technical Develop-

ment, observed that pluralism implies the availability of expertise to entities such as labor unions, consumer organizations, and groups of concerned citizens. It also implies the formulation of many alternative conclusions from an available set of data in order to provide the public with a menu of choices. An essential ingredient in this pluralistic approach, added D. Bruce Merrifield (Vice President of Technology in The Continental Group), is the participation of non-technical people at the earliest stages "in order to develop consensus for concerted action" later on.

Today's scientific activists have challenged the ways in which technical decisions are being made, said Professor Dorothy Nelkin (Program on Science, Technology and Society, Cornell University). Demanding "accountability," "demystification," and "participation," they have engendered pluralism even within the technical community itself. "When polarity-opposites meet," she observed, "they don't necessarily change their minds, but they do recognize that human beings are on the other side." This allows for accommodation — the eventual coming-together on common ground — and more enlightened decisions may emerge.

Polarity-opposites did meet at the conference, although not in equal numbers. William Winpisinger, President of the International Association of Machinists and Aerospace Workers, told his predominantly corporate audience during a luncheon address that the attenuated pace of innovation is no accident, and is actually part of an explicit policy to maintain the status quo. The "corporate state," he asserted, systematically suppresses and delays potential innovations in order to enhance existing product lines, to protect investments, and generally to preserve the current distribution of wealth and privilege. Thus, in Winpisinger's view, science has become industry's weapon in a "class warfare initiated not by revolutionary workers, but by an elite managerial class."

The audience was stunned. But who ever promised that pluralism would be a rose garden?

Philip Handler, at another point during the conference, basically put it all together in a simple and direct way. "It is difficult," he said, "to claim that technology has advanced society. It has certainly advanced some individuals, but not groups of individuals. And attention to how this might become a better world for more people, while remaining attentive to individual aspirations, might well be our constant goal." — S.M. □

ENERGY CRISIS!

Here we go again!

Were you lulled into a false sense of security during the last few years about our energy situation? Did you think you would never have to wait in line for gas again? Well, welcome back to 1974 — and the future!

The editors of Technology Review have reprinted six very timely articles to help you understand the crisis, its long-term nature, and the implications for your lifestyle and pocketbook. Alternative energy sources, energy policymaking, the management of energy transition, and much more to keep you in touch, informed and never lulled again.

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No More Free Ride... For Union Officials.

Thanks to Harry Beck, American workers no longer have to support unwanted candidates or undesired political causes to keep their jobs.

Harry, who was born and grew up in LaPlata, Maryland, has worked for the telephone company for 19 years. He once belonged to the Communications Workers of America union, but resigned "because the CWA was totally impersonal to anyone except those at the top."

However, "those at the top" in the union then negotiated a contract with the telephone company which required all non-union employees, like Harry, to pay CWA an "agency fee" equal to union dues to stay employed.

Harry Beck had to pay up or be fired. But then he learned that the CWA, one of the country's most politically active unions, was using the "agency fees" for partisan politics—and that made him mad. "They backed people," explains Harry, "I just wouldn't have backed."

With the help of the National Right to Work Legal Defense Foundation, suit was brought against the CWA union for Harry and 19 other telephone company workers. And on March 16, 1979, in an historic decision, a Federal court ruled that a union's collecting or spending of compulsory fees for any purpose other than collective bargaining violates the Constitutional rights of employees who object.

It was the first time that a Federal court had declared that union political spending from mandatory "agency fees" is an infringement upon the rights to free speech and association enjoyed by private sector workers.

Similar protection was established for

public employees last year in the U.S. Supreme Court decision in *Abood v. Detroit Board of Education*—another case supported by the National Right to Work Legal Defense Foundation.

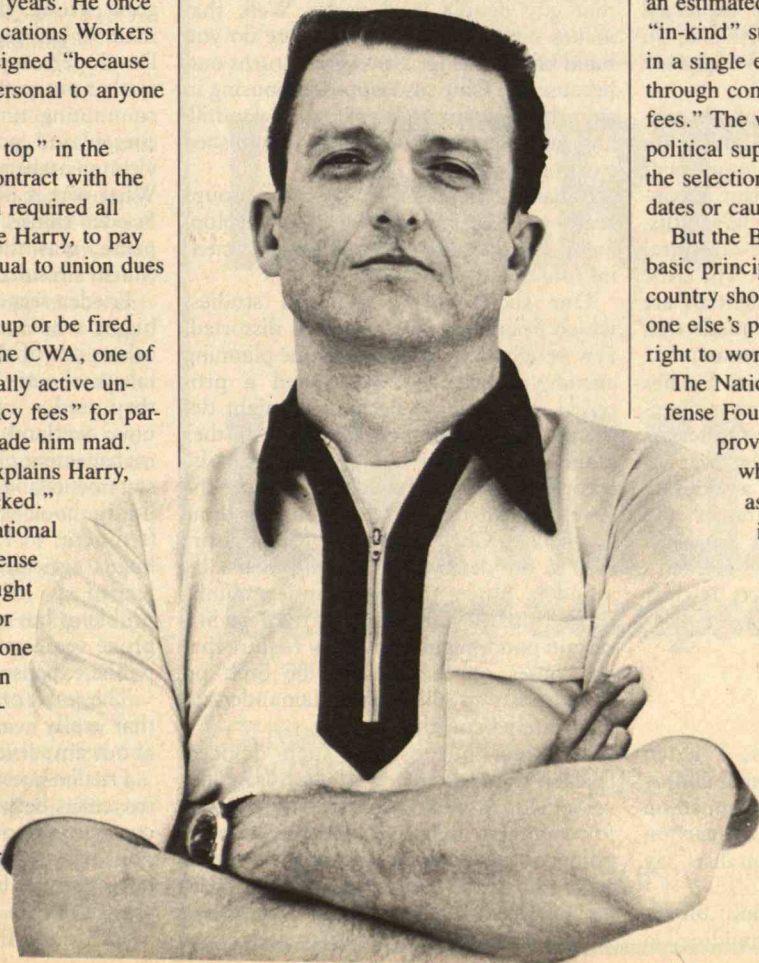
The potential impact of the two decisions is enormous. Union officials spend an estimated \$100 million in direct and "in-kind" support on political campaigns in a single election year—most of it raised through compulsory dues or "agency fees." The workers forced to pay for this political support have rarely any voice in the selection of the union favored candidates or causes.

But the Beck decision reaffirms the basic principle that no worker in a free country should ever have to support anyone else's politics in order to retain his right to work.

The National Right to Work Legal Defense Foundation, established in 1968, provides free legal aid to workers whose rights have been violated as a result of compulsory unionism. It is presently supporting more than 100 court cases involving the rights of employees across the nation.

If you'd like to help workers like Harry Beck, we'd like to hear from you.

National Right to Work Legal
Defense Foundation
Suite 600
8316 Arlington Blvd.
Fairfax, Virginia 22038



Environmentalists: Protecting Our World or Their Turf?

The Environmental Protection Hustle

Bernard J. Frieden

Cambridge, Mass.: The M.I.T. Press, 1979, 183 pp.; \$12.50

Reviewed by Robert Campbell

When Proposition 13 rolled back property taxes in California last year, there were many explanations. Some said the movement was part of a trend to conservatism, others said it was a reaction to inflation. Still others fixed the blame on real estate speculators, who were said to have driven the price of homes in California so high they brought on reassessments that doubled or tripled homeowner's taxes. About the only people no one thought of blaming were the environmentalists. These are idealistic people and organizations, such as the Sierra Club, who fight the good fight for trees, clean air, and protected open space, and who sally forth like St. George to slay the dragons of "sprawl" and "ticky-tack development."

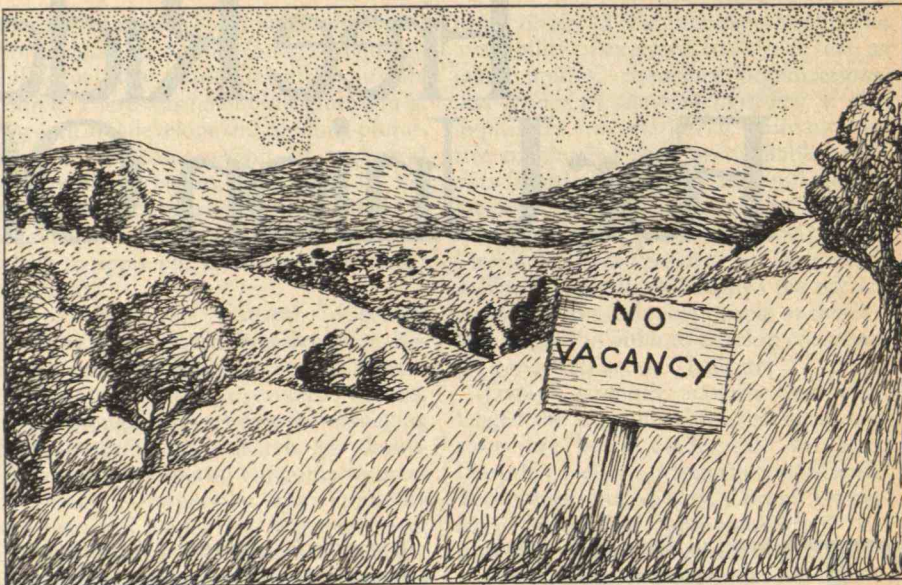
Thus it comes as something of a bombshell that a respected critic should announce that the environmental movement is little but a cover-up for elitism, a conspiracy of the haves against the have-nots, and a major cause of the price-tax spiral that brought on Proposition 13. The critic is Bernie Frieden, and his credentials are so strong and his case so well made that it's likely to have national repercussions.

Frieden is Professor of Urban Studies and Planning at M.I.T. and former director of the Harvard-M.I.T. Joint Center for Urban Studies. In 1975-76 he was at Berkeley, where he witnessed a series of conflicts between environmentalists and developers trying to build new homes in the San Francisco Bay area. Frieden's conclusion about those conflicts is clear from the title of his book: *The Environmental Protection Hustle*.

Costs of Protection

Bay area environmentalists, Frieden claims, bogged down one homebuilding proposal after another for trumped-up reasons that had no honest connection with the goals the environmentalists say they care about.

The San Francisco Sierra Club, for instance, opposed new homebuilding in



Anthony Russo

rural areas because it would destroy open space and increase commuting time and, therefore, air pollution — which makes sense. But the Club also opposed housing on open space near the city on the grounds that city people need parks. Well, that makes sense too. But then where do you build new housing? Nowhere, it turns out, because the Club also opposed housing in suburban locations, housing on landfill, and housing that would have demolished existing structures.

What the Sierra Club and other groups really oppose, Frieden claims, is development and they use whatever environmental tool comes handiest.

One such tool is technical studies, which Frieden claims are often distorted. Few people love coyotes, but one planning agency nevertheless questioned a proposed development because it might deplete the coyote population. Another wondered whether bald eagles might be inconvenienced by having to fly over the development, though none had ever done so. In Santa Cruz, the board of supervisors rose to the defense of the long-toed salamander. Since the salamander climbs down from the hills each year to breed in a certain pond, regulations now require that all houses on the hillsides be built on raised posts to allow the salamanders to pass safely beneath.

The real purpose of such devices, Frieden thinks, is often to discourage development or raise its cost. The concern for animals often hurts people. Frieden points out that the one group never represented in all the controversies is the families who will buy the homes if they ever get built. Invisible, they suffer silently.

Unholy Alliances

Often environmentalists damage their own interests. In Marin County, north of San Francisco, anti-homebuilding fever grew strong, despite the fact that more than 90 per cent of Marin is open space. Developers, repulsed from Marin, moved farther out to Sonoma County, increasing commuting times and creating the very energy and pollution problems the environmentalists say they worry about. What was really saved in Marin County, Frieden thinks, at considerable public expense, was the comfortable lifestyle of Marin's residents.

Frieden sees an unholy alliance between bigots who have always wanted to keep others out of their lives, and environmentalists who are handing them the weapons they need — water and sewer moratoriums; wetland, flood plain, and coastal management plans; environmental impact statements and lawsuits challenging them; utility hook-up charges; absurd zoning (ten acres in Palo Alto), and creation of bogus agricultural preserves that are defended as helping solve world hunger problems but really exist because they improve someone's scenic view — again, at public expense.

The result of all this is to give any group that really wants it a way to keep just about any development off its turf.

Frieden guesses that environmental controversies between 1970 and 1977 halted construction of about one year's normal housing supply in the Bay Area. He believes this has been a major factor in pushing California home prices to the highest in the nation. One planner, quoted by

Frieden, defines a homebuilder as a man who wants "to make a buck by raping the landscape." People who feel that way, Frieden thinks, are often people who already have their own homes. He accuses them of "lifeboat morality": we're safe on board, let's not let anyone crowd us.

He makes a persuasive case.

Robert Campbell is a practicing architect in Cambridge, Mass., and architecture critic for The Boston Globe from which this commentary is reprinted by permission. □

Citizen Action and Environmental Policy

The Environmental Impact Statement Process: A Guide to Citizen Action
Neil Orloff

Washington, D.C.: Information Resources Press, 1978, ix + 242 pp.; \$10.95 (plus \$1.85 postage and handling)

Reviewed by Deborah Baldwin

When it comes right down to it, there is nothing especially radical about the National Environmental Policy Act, a nine-year-old law considered to be one of the landmark achievements of the environmental movement. N.E.P.A. (as it is better known) didn't ban anything, exact any penalties, or set in motion any new regulatory apparatus. Basically, all it requires is that the federal government investigate the environmental impacts of some of its projects before deciding to go ahead with them. N.E.P.A. doesn't even demand that government officials follow the recommendations of a given environmental impact statement.

But N.E.P.A. does require that some time, money, and energy be channeled into environmental assessments, and this process provides citizens groups with ample opportunity to participate in the planning process. An environmental impact statement (E.I.S.) can be a major undertaking, and after it is written there's a period for review and comment. If an E.I.S. is inadequate, citizens can demand that additional time and effort go toward rewriting it. Understandably, N.E.P.A. has not been a popular law among business interests nor among the various government agencies directly affected by it.

Does semantics imply socialism?

An uncompromising attack on the socialism of linguist-philosopher Noam Chomsky, **LIBERTY AND LANGUAGE** offers a challenging, closely reasoned argument in favor of classic liberalism. Geoffrey Sampson, linguistic expert and author of **THE FORM OF LANGUAGE**, shows through his study of semantics how socialism fails to accomodate — let alone encourage — fundamental expressions of human creativity. His new book is a bold rallying cry for political moderates, including those with no special interest in linguistics.

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Reviewing the E.I.S. Process

Many of N.E.P.A.'s critics mistakenly assume that it was passed after Earth Day in April 1970, when thousands of Americans poured out in the streets to rally for tough pollution controls. Actually, N.E.P.A. was signed into law four months earlier. Its scope was thought at that time to be so modest and, one is tempted to say, so down to earth that no one paid much attention to it.

It was only later, after various court rulings had dramatized N.E.P.A.'s power to block or delay federal projects, that opposition to the law began in earnest. About once a year now someone in Congress decides to campaign against the law, or seeks to exempt a certain project from having to comply with it, and the debate starts up again. Why must we have N.E.P.A., its opponents complain, and why should we go through the tiresome and expensive process of writing impact statements?

The reasons are straightforward and convincing. Traditionally it has been our fate to learn about the impacts of human activities only through trial and error. We build the road, divide the neighborhood, increase the traffic flow, and only then discover that we've created more problems that we've solved. N.E.P.A. was designed to reverse things, so that planners and citizens could anticipate the impacts — both direct and indirect — of major

projects and come up with an assessment of alternatives. It is an eminently sane way to help make decisions about federally funded projects — although granted, it is not the way things have been done in the past.

Now that N.E.P.A. is close to ten years old, there's renewed interest among critics and supporters alike in studying how well the law has worked and ways it can be improved. Much has been written about *pro forma* compliance with the law — about the massive E.I.S. detailing each blade of grass and twig that is never read; or the government agencies that decide to proceed with a project and only later agree to review its impacts; and the sticky tape that's inevitably involved, sometimes for no apparent reason, in having several federal agencies review an E.I.S. Partly as a result of these criticisms, the President's Council on Environmental Quality last year issued guidelines aimed at streamlining the E.I.S. process and reforming some of the worst abuses of the law.

Neil Orloff helped write those guidelines, and today, as director of Cornell University's Project on Environmental Impact Statements, he has a unique understanding of how N.E.P.A. is supposed to work. His book is not a treatise on the philosophical controversies surrounding N.E.P.A., but rather an analysis of how citizens can learn from the experience of others and apply N.E.P.A. as sensibly and realistically as possible. One of the best ways to insure the law's future, he seems to be saying, is to respect not only its potential but its limitations.

Orloff fearlessly plunges into the particulars of the law right at the beginning. He is careful to explain what an E.I.S. can and cannot accomplish, and he stresses that in order for citizens to make much headway they must persevere against great odds. *The Environmental Impact Statement Process*, then, is a how-to book for organized groups that are well equipped to settle in for lengthy, uphill battles.

Best When Non-Political

Orloff is honest and thorough. He has put himself in the position, however, of walking a tightrope — between advising citizens about ways to involve themselves in decisions that are often highly political, on the one hand, while arguing that N.E.P.A., when used correctly, is most valuable when it is non-political — when an E.I.S., for example, is restricted to information that is objective and factual.

It is the process of sorting out the pros and cons of a given project by community members and the overseeing federal agency, of course, that charges an E.I.S. with political overtones. In the end, even if an E.I.S. is "objective," someone must decide whether a project is worth going ahead with. Do the costs — environmental and social, long-term and immediate — outweigh the benefits? How can these costs be quantified? What are the alternatives? Who will benefit, and at whose expense?

Orloff is obviously sensitive about these matters, but he hesitates to deal with them. His answer is basically to exhort citizens to present their arguments as cogently as possible, and he avoids labeling government agencies and industrial interests as the enemy, even though that is the way many citizens groups often feel about them. Indeed, government bureaucrats, despite their disproportionate amount of power, are treated gingerly, as if they were simply a bit more easily ruffled and in need of more coaxing than the rest of us. "It is important to establish a good relationship with the agency [in question]," Orloff writes in his understated way, adding, "At times, citizen groups can aid these agencies by informing them of issues or controversies involving the project, about which they might be unaware."

This admonition and others, one can only assume, are based on Orloff's firsthand observations, and as far as they go they should provide valuable insights for local environmental groups. Examples of specific E.I.S.s, along with descriptions of how they have or have not contributed to public debate, add to the book's value.

Orloff's failure to confront some of the larger issues surrounding environmental activism is a disappointment. But, as he himself hastens to point out, *The Environmental Impact Statement Process* wasn't written with larger issues in mind. Rather, the book is a useful, if somewhat two-dimensional, citizen's guide. Countless environmental groups, faced with the challenge of reviewing E.I.S.s and trying to read between their lines, will use this book and be thankful for it.

Deborah Baldwin is an editor of *Environmental Action magazine*. □

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6/79

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Bennis

Continued from p. 13

these years.

□ Free items: The Morgan Guaranty Trust Co. in New York offers a monthly report on the U.S. economy, and Metropolitan Life Insurance Co. publishes a monthly *Statistical Bulletin* tracing important demographic trends and their consequences. Good, but not quite free, are *Manas*, an idiosyncratic charmer tending toward philosophy and the history of ideas, and *Brain/Mind*, a model of less-is-more with a neat four-page format containing almost as much information as one issue of *Psychology Today*.

Diet Supplement for the Hardy

People vary in their reading metabolism. Some, like former president John F. Kennedy, have a high I.O.A. threshold. Harold Lasky was famous, too, for devouring everything in sight and still remaining free from nagging symptoms; he could digest an average book in minutes. For the lucky few such as these, who do not require a strict regimen, the following may be included as a supplement to the basic maintenance program.

Group V: Management and Business. That we live in a corporate society is the best-kept secret in the daily press. To find the business section, look somewhere between sports and classifieds. Business/management magazines, however, are burgeoning. A favorite is *Business Week*, which is timely and easily digested. It tends to items you can take in from beginning to end on one page. Its longer features are superb fare: "Washington Outlook," "Social Issues," and "Book Reviews."

Group VI: Science and Technology. No noshing here: this group contains no junk additives. "News and Comment" in *Science*, for example, is a heavy meal-in-one — substantive and comprehensive. But as a publication of the American Association for the Advancement of Science, *Science* is really a giant tarpaulin which covers all of the sciences, theoretical and applied, from dentistry to hydrology. So much of the magazine threatens to make a major contribution to the disease we've set out to eradicate. *Scientific American* too often gives the specialist too little and the nonspecialist too much, leaving you either hungry or overstuffed. *New Scientist*, from England, is staffed with perhaps the most able science-writers around. It is often intelligent and timely, and it gives the slimmed-down layman an overview of everything from the economics of micro-processors to fossilized footprints.

If there were one all-purpose compound which included the sound ingredients of all the science magazines, I would happily recommend it. In the absence of that, my recommendation is to stay with the one you're reading now. □

engineer

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Argonne National Laboratory has a position of unusual professional interest for an engineer who can manage the cost/performance assessment of Satellite Power Systems versus other options for meeting the future energy needs of the United States.

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The Universe: Source and Fulfillment of Life

"Puzzle Corner" by Allan Gottlieb appears on pages A37 to A40 of this issue of the Review; if your edition does not include these pages (center supplement), request a print from the editors at Room 10-140, M.I.T., Cambridge, MA 02139.

1Q	2W	3H		4B	5G	6X	7A	8H	9Z	10N		11X	12C		13P	14G	15A	16F	17I	18V	
19C	20I		21G	22X	23Y		24X	25W	26Y	27T	28S	29C	30I	31O		32P	33I	34G		35V	36R
37W	38V		39K	40G		41E	42F	43H	44Q	45T	46Z	47H	48V	49W	50P		51A	52H	53J	54Q	55V
56X	57Z ₁	58I	59N	60P		61R	62H		63Y	64X	65B		66J	67G	68U	69W		70D	71G	72V	73Z
	74E	75M	76C	77I	78S		79U	80P	81E	82R		83G	84H		85A	86I	87G	88K	89Z	90J	91L
92X		93I	94H	95D	96Z		97N	98W	99Z ₁		100O	101C	102I	103S	104R	105Z ₁	106F	107G		108B	109G
110R	111N	112S	113A	114F	115I	116O		117M	118W		119X	120V	121R		122L	123X		124Z	125L		126H
	127G	128K	129O	130S	131W	132Z ₁	133M	134P		135D	136Q	137W	138Z ₁	139C	140G	141F		142F	143E		144I
145O	146W	147K		148M	149P	150R	151X	152E	153K	154W		155V	156J		157S	158G	159I		160A	161J	162O
163D	164S	165L	166W	167Z ₁	168G		169Y	170W		171I	172F	173W		174A	175I	176Y	177T	178O	179C		180A
181E	182I	183W	184B	185H	186J	187X		188B	189G	190J	191O	192S	193W	194C	195E	196L	197N	198Q	199V	200K	
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219B		220W	221I	222Z		223A	224G	225J	226O	227U	228Y	229Z ₁	230I		231V	232U	233E		234N	235C	236Y
	237D	238F	239I	240M	241R	242V	243X	244Z	245G	246J	247N	248Y		249X		250H	251M	252Q	253X	254T	
255X	256Z ₁		257C	258E	259L	260O	261Q	262T	263Y	264G	265P	266W	267F								

After 25 years as a student (Harvard) and teacher of music, Robert Forsberg turned to the Lowell Institute School for training in mechanical engineering; he is now chief design engineer at Lion Precision Corp., Newton, Mass. Solving "croctic" puzzles has been a long-time interest, and building them has recently become a special passion.

A solution to this Tech-Croctic will be given in the next issue of the Review, when another of Mr. Forsberg's puzzles will also

appear. Readers are invited to comment — and to suggest favorite texts for future puzzles.

Complete the word definitions; then enter the appropriate letters in the diagram to complete a quotation from an article on cosmology. The first letters of the defined words give the author and title from which the quotation is taken. Black squares in the diagram indicate the ends of words; if there is no black square at the right end of the diagram, the word continues on the next line.

A. Penultimate remark of Julius Caesar	223	85	7	51	113	160	180	15	174
B. An arsenal and a missile	188	65	4	219	203	209	108	184	
C. Verdi opera (three words)	257	139	235	179	12	76	217	194	101
								29	19
D. "The aristocrat who banks with" (G&S, <i>Gondoliers</i>)	237	163	213	95	70	135			
E. Voracious fishing bird, genus <i>Phalacrocorax</i>	41	143	233	258	81	152	74	181	195
F. "Sing, Sorry for Some" (G&S, <i>Princess Ida</i>) (comp)	172	114	238	16	141	142	42	106	202
								267	
G. Strauss opera (two words, with "Die")	140	109	87	34	127	245	83	168	107
	71	189	158	5	264	40	224	14	
H. So as to occupy the intervening spaces	67	43	84	3	185	250	21	94	208
					8	126	52	47	62
I. Subject of Charles Siem's stress analysis	205	171	115	33	212	102	58	77	30
	17	239	159	221	182	175	144	230	86
								93	20
J. Lazy, inefficient	225	90	246	156	53	66	161	190	186
K. Mexican reformer and president, 1880-1928	128	39	214	88	200	153	147		
L. Quantity	125	196	259	122	91	165			
M. Shell of marine gastropod, genus <i>Cypraea</i>	148	133	117	75	240	251			

N. Science of mountains	97	197	234	59	247	111	10		
O. Armored dinosaur of the Upper Jurassic	116	191	31	100	260	129	145	210	178
								226	162
P. A Thessalian at Troy	32	60	80	13	265	50	149	134	
Q. First part of the Proper of the Mass	54	252	1	261	136	198	44		
R. Drama of 1611	104	121	82	61	36	241	110	150	218
S. Infraclass of placental mammals	28	164	157	112	78	192	130	103	
T. "The peerage is not destitute of" (G&S, <i>Iolanthe</i>)	27	177	45	262	206	254			
U. German composer, 1895-	232	226	68	79					
V. Phenomenon of low Reynolds numbers (two words)	48	120	55	242	199	72	18	231	38
								155	35
W. An alias of Jean Valjean (Hugo, <i>Les Misérables</i>)	193	154	131	146	137	49	170	220	98
	166	2	118	37	69	183	173	25	266
X. Comedy of 412 B.C.	151	64	187	6	119	11	215	22	255
	92	201	249	243	24	253	56	123	
Y. Repetition	26	176	23	236	263	63	228	169	248
Z. One of the dental sciences	216	211	73	96	46	222	204	9	89
								124	244
Z ₁ . Egyptian queen, famed for her beauty	229	138	256	167	99	57	207	105	132

Vitamin B₆ vs. Arteriosclerosis

Though most of us accept it, the correlation of high levels of serum cholesterol with arteriosclerosis — hardening of the arteries — is far from perfect; and the relation of high diet cholesterol to high serum cholesterol is at least as imperfect.

Perplexed by these anomalies, two neurophysiologists — Dr. Edward R. Gruberg and Dr. Stephen A. Raymond — in the M.I.T. Research Laboratory of Electronics turned to the literature of protein nutrition and heart attacks. Now, two years later, they've emerged with a new theory which challenges the conventional wisdom and therapy for managing heart attacks and strokes.

Their interest was provoked in 1976 when Dr. Kilmer McCully of Harvard Medical School and Massachusetts General Hospital showed that homocysteine, an amino acid produced in the course of digesting meat and other proteins, could cause arteriosclerosis. But homocysteine is highly toxic, and at least most people convert most of it very quickly into a very different and useful amino acid called cystathionine.

The conversion requires vitamin B₆.

Most of us don't think much about vitamin B₆; it's present in considerable quantities in much of the food we eat, and Drs. Gruberg and Raymond admit that "at first glance it seems unlikely that many people could be deficient in it." An exception, long recognized, are rare patients with a disease called homocystinuria, where the conversion of homocysteine is somehow impeded. For these patients arteriosclerosis is a serious risk, and large doses of vitamin B₆ are a normal prescription.

A more careful analysis now leaves Drs. Gruberg and Raymond less confident about vitamin B₆ levels for the rest of us. Much of the vitamin B₆ in meats and vegetables is lost in cooking and processing; "several studies have shown that most Americans eating normal diets do not have adequate levels of vitamin B₆," they write, and "virtually all Americans over 60 are vitamin B₆-deficient."

Drs. Gruberg and Raymond, writing in the May issue of the *Atlantic*, propose that the conversion of homocysteine is in fact impeded by lack of vitamin B₆ in the diets of many of the world's most "civilized" people; hence the rising tide of arteriosclerosis in the "westernized" societies. Government standards suggest that 2 milligrams a day of vitamin B₆ is

adequate for all adults; many Americans don't get that much, and Drs. Gruberg and Raymond think that 10 milligrams per day "would be more likely to give an adequate margin of safety." "Megadoses" aren't indicated — but probably wouldn't be dangerous.

They admit that this homocysteine theory is no more than that, awaiting confirmation by scientific and clinical tests. Those will take a long time, because arteriosclerosis is itself a disease slow to develop in maturing adults.

Meanwhile, Dr. Robert S. Lees, Professor of Cardiovascular Disease in the Department of Nutrition and Food Science at M.I.T., surprised many of his faculty colleagues by the vigor of his response supporting more conventional theories of cholesterol and arteriosclerosis: the homocysteine theory is "errant nonsense," he told two medical reporters from the *Boston Globe*, and Drs. Gruberg and Raymond are perpetrating "a hoax. . . . Nothing they say has anything to do with any legitimate evidence on the matter," said Dr. Lees (he is the director of the Arteriosclerosis Center at M.I.T.). □

Automatic Diabetes Management

A major breakthrough for diabetics — an automatic, implanted glucose-insulin control system — has been sketched by Professor Clark K. Colton of the Chemical Engineering Department. The system would include a glucose sensor, an insulin reservoir and pump, and some electronics connecting the two: if the sensor found glucose levels rising, an appropriate amount of insulin could be pumped into the blood stream — automatically.

The glucose sensor is the crucially hard part of the system, and the design task is hardly more than begun. But an electrode of porous platinum submerged in bovine serum has now been made to show an increase in current which is proportional to an increase in glucose concentration in the serum. □

Acoustic Stress Analysis

When a magnesium alloy bar is stressed — even far below the breaking point — it emits some sound, inaudible to human ears but easily recorded by sensitive microphones. These acoustic emissions turn out to be "generally repeatable" — different specimens having the same load his-

tory will make the same sound when reloaded, and then again when unloaded.

But the sounds generated upon unloading contain some historical information: they seem to depend on stresses previously absorbed by the material. That's important, and James H. Williams, Jr., Associate Professor of Mechanical Engineering, thinks stress analysis capitalizing on these acoustic effects may be an important new technology. □

Engineers Needed in the Executive Suite

Can the U.S. win its life-or-death struggle to maintain its technological leadership over most of the world's industrialized nations and regain its economic stability?

Maybe, if we do the right things quickly and decisively — if we can rebuild the nation's faith in technology and turn around its economic priorities, says Thomas F. Jones, Vice President — Research of M.I.T.

"The U.S. is pitted against the rest of the world, but principally Japan, in an economic struggle for the high-technology business," Dr. Jones told more than 100 members of the M.I.T.'s Alumni Council early this spring. "Japan is moving ahead rapidly," he said; and, paradoxically, the U.S. is Japan's biggest customer — almost like a lamb trotting happily to slaughter.

Dr. Jones attributes U.S. problems chiefly to two basic policies: "We freely give away our technological know-how, and we have a deep commitment to the principle of maximizing return on investment."

To reverse current trends, Dr. Jones urged a series of policy reforms:

□ Restrain anti-trust actions. It's not that Dr. Jones wants to turn American corporations loose to become "robber barons," he says; but he is concerned that U.S. companies cannot now pool research efforts and that they can share new technology only through publications — a policy which makes new knowledge available to all the world.

□ Control the export of what Dr. Jones calls "naked technology." American corporations have found that they can earn good income at little risk by selling "naked technology" in the form of patent rights and know-how to foreign companies, who then produce and sell its fruits. Under our tradition of free trade, these products of our know-how are then welcomed as imports "as a matter of national policy. The result is that foreign high-technology interests are prospering

on U.S. know-how while over 6 per cent of the American work force is unemployed," Dr. Jones said.

□ Create a climate more favorable to new capital investment which will increase productivity. (Specific recommendations on this have just gone to President Jimmy Carter from Jordan J. Baruch, Assistant Secretary of Commerce, and Frank Press, Director of the Office of Science and Technology Policy.)

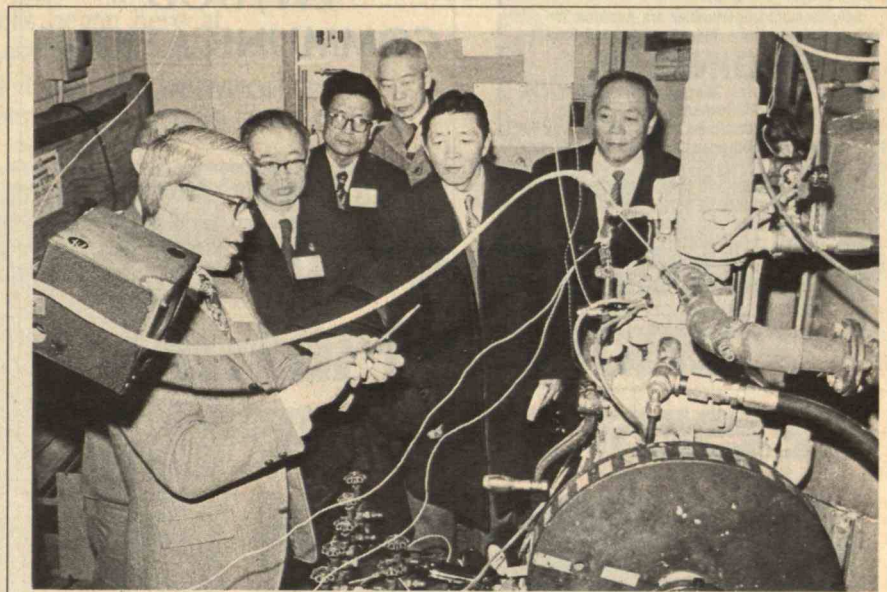
□ Take an aggressive role in making the U.S. an effective exporting nation. "The Japanese have become real professionals in production and marketing for international trade," said Dr. Jones, and he wants the U.S. to take a leaf out of their book. For example, the Japanese Ministry of International Trade and Industry provides low-cost capital to industries with high export potential.

□ Increase our investments in basic research — especially in universities. "No other social institution is comparable to the university for fostering basic research," said Dr. Jones, "for no other social institution brings together the environment and values favorable to it."

□ Reestablish the creative, innovative role of engineering in U.S. enterprises. It used to be that way; but then U.S. corporations, single-mindedly measuring success in terms of maximum return on investment, turned away from producing goods and became distributors and servicemen. Problems, risks, and the need for capital were reduced. But so were the opportunities for corporate research and development, innovation, and technical know-how. As a result, "the U.S. has moved away from its clear position as technological leader of the world," said Dr. Jones.

(A cheer from the audience: Myron Tribus, Director of M.I.T.'s Center for Advanced Engineering Study, added his own footnote: trouble began, he thinks, when U.S. industrial leadership fell out of the hands of engineers and into the hands of professional managers. Trained only to watch the "bottom line," they chose to emphasize short-term profits at the expense of excellent design and quality production. "This situation can only be turned around," declared Dr. Tribus, "when the U.S. professions of engineering and management get together and recognize the important role of engineers in the management of technology.")

"Consider three islands," said Dr. Jones, citing a parable he'd recently heard. "The first imports and consumes both products and energy and exports knowledge. The second exports energy and con-



So many delegations of visiting scientists have come to M.I.T. from the People's Republic of China that their official M.I.T. host, Provost Walter A. Rosenblith, has lost count. The picture

shows Joe M. Rife (left), lecturer in mechanical engineering, with a group from China's Society of Automotive Engineers in the Sloan Automotive Laboratory. (Photo: Calvin Campbell)

sumes very little. The third imports and consumes energy and knowledge and produces and exports products. If this relationship is allowed to persist, the first island will become owned by the other two." His audience caught on quickly enough. — J.M. □

Making Diesels Cleaner

If diesel engines can be made to meet the 1983 standards for particulate emission, they may power 20 to 25 per cent of the nation's passenger cars by 1990: the diesel may, in fact, be the only way American automakers have of providing five-passenger cars within the miles-per-gallon mandates of Congress.

But diesels generate soot. The air and fuel do not thoroughly mix before combustion, and unburned fuel comes out as soot with the exhaust gases. Four interrelated studies in the M.I.T. Energy Laboratory bear on a possible solution:

□ Professor John B. Haywood leads a group seeking to model temperatures, pressures, fuel-air ratios, and combustion throughout the cycle of a diesel engine.

□ Joe M. Rife and Jack Ekchian are building a single-cylinder test engine in which to verify the model-makers' results.

□ Professor John P. Longwell is making

basic combustion studies on soot formation and fuel burn-up.

□ Professors Ronald A. Hites and William B. Thilly are planning and building a laboratory in which to study the characteristics of various soot samples. □

How to Deal with a Gas Crisis

Rationing is only one of several ways to conserve gasoline. Here are three others, selected by the Department of Energy from a list proposed by M.I.T.'s Energy Laboratory and Center for Transportation Studies:

□ Make employers responsible for cutting their workers' use of gasoline — any way they like: reduce parking privileges, provide van pools, adopt four-day weeks, whatever.

□ Assign every automobile its day or days to remain at home — unused.

□ Restrict recreational energy use by private planes, boats, and such vehicles as campers and four-wheel-drive trucks.

These and other alternatives are now under intensive evaluation by M.I.T. specialists in economics, law, environmental science, psychology, political science, transportation, and engineering. Will they work? And how well? □

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"Tunable semiconductor diode laser" is a long name for a speck of lead-salt crystal. When tuned (by adjusting temperature) to emit the infrared wavelength that a particular gas can absorb, this tiny device can beam through a mixture of gases and quantify even small amounts of the targeted gas.

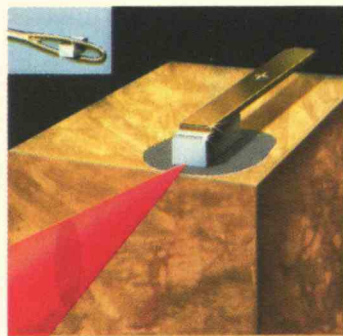
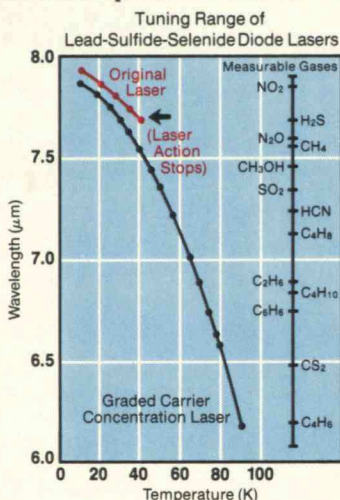
When research on diode lasers began here at the General Motors Research Laboratories, their tuning range was limited to about 1% of the infrared spectrum. Even modest temperature increases (to extend tunability) caused energy losses in the crystal that stopped laser action.

However, by producing a unique form of lead-sulfide-selenide single crystal that reduces these losses, our physicists developed a new type of semiconductor laser having 10 times the tuning range.

There were problems besides limited tunability. One was degradation from diffusion of the electrical contact material, indium, into the crystal. Interposing layers of gold and platinum ended that difficulty.

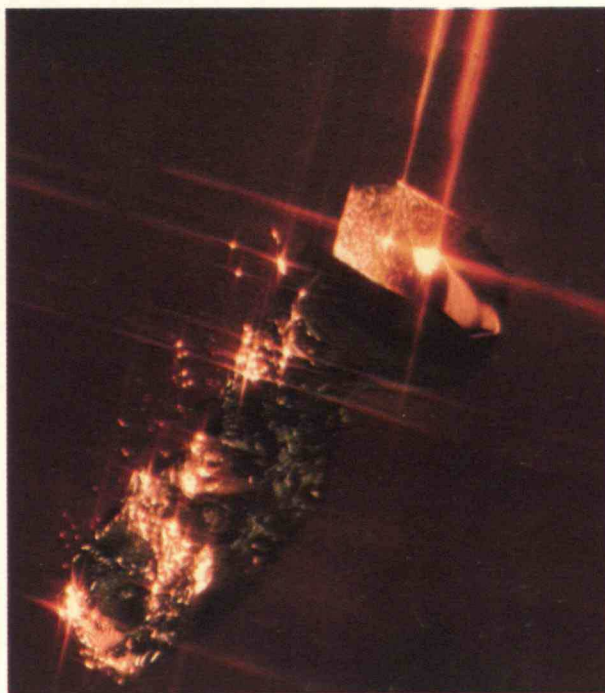
Another problem: The crystal would separate from the heat sink after repeated cycling down to the necessary cryogenic temperatures. That, too, was resolved . . . by a better chip-mounting arrangement.

As a result of these and other advances in tunable semiconductor diode lasers, even the sky won't be the limit of their usefulness. For example, such miniature searchlights may permit the measurement of gases surrounding the planets. They are already scheduled by NASA for satellite probings of our own stratosphere. And here on earth, they're now ready to play a significant role in monitoring pollution.



Semiconductor diode laser
Indium contact material
Infrared beam
Heat sink and electrical ground

More tunability, more durability for the world's smallest lasers.



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